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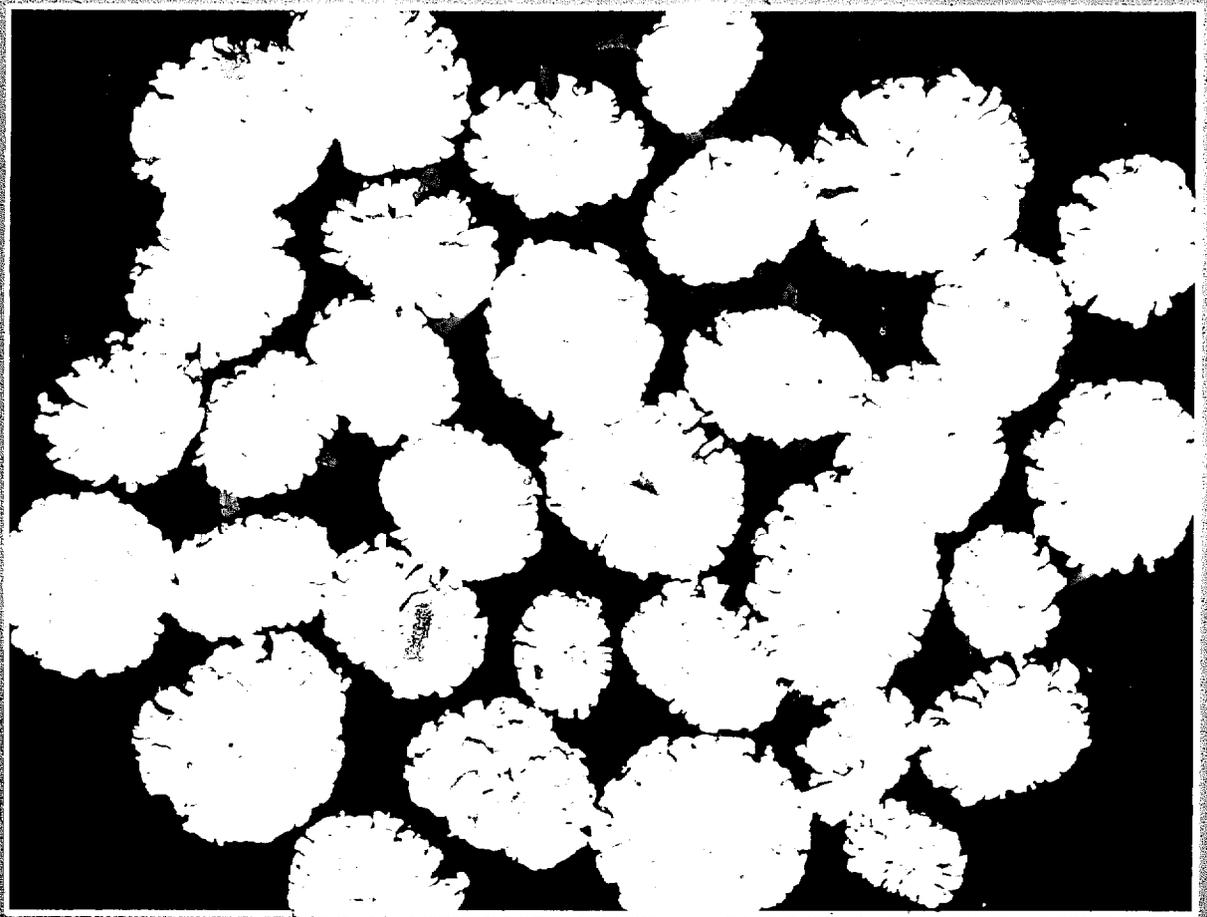
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PLANTS & GARDENS

THE GREAT BRITISH BOTANICAL SOCIETY RECORD

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NATURAL PLANT DYEING A HANDBOOK

GOOD PLANTS FOR DYEING
COLLECTING AND REARING
MATERIALS - THE CHEMISTRY OF DYEING
Preparation for Reagents and Colours
Natural Dyes, Sources
Dyeing in Other Countries

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HANDBOOK ON NATURAL PLANT DYEING

CONTENTS

African Marigold Flowers for the Dyebath	Philip B. Mullan	Cover
Among the Contributors		Inside Front Cover
A Step in the Dyeing Process: Rinsing; Gathering Carrot Tops	Philip B. Mullan	2
Letter from the Brooklyn Botanic Garden		3
Natural Plant Dyeing	Palmy Weigle	4
Chart of Common Mordants	Mollie Harker Rodriguez	5
Collecting and Storing Natural Dye Materials	Palmy Weigle	7
Natural Dyeing in the Classroom	Mollie Harker Rodriguez	8
Preparation of Sheep Fleeces for Dyeing	Edna Blackburn	15
Madder Root	Palmy Weigle	16
Dye Plants of the Deep South	Willi and Fred Gerber	17
Pokeweed	Palmy Weigle	22
Blue Goes for Down	Esther Warner Dendel	23
Indigo	Palmy Weigle	26
A Method for Storing Dyed Wool Samples	Nellie Bergh	28
A Practical Approach to the Use of Lichens	Phyllis Yacopino	29
Coreopsis for Reds on Cotton and Wool	Esther K. Hasel	33
The Sleepy Hollow Restoration Shawls	Sylvia Thorne	34
The Rowan-tree		36
A Substitute for a Traditional Dyestuff	Miriam B. Hewitt	37
Color in Iceland	Astrid Swenson	39
A Dyeing Project in Sweden	Astrid Swenson	40
The Australian Eucalypts	Jean K. Carman	42
The Florist Eucalyptus	Palmy Weigle	45
Plant Dyeing in New Zealand	Joyce Lloyd and Molly Duncan	46
A Workshop on Nantucket	Mary Ann Beinecke	49
The Chemistry of Dyeing	Beth Parrott	51
A Color Range from Cochineal	Palmy Weigle	57
Words to a Young Weaver		59
Southwest Navajo Dyes	Noel Bennett	60
Books for Further Reading	Elizabeth Alexander	63
Dye Plant Supplies	Palmy Weigle	64
Index		Inside Back Cover

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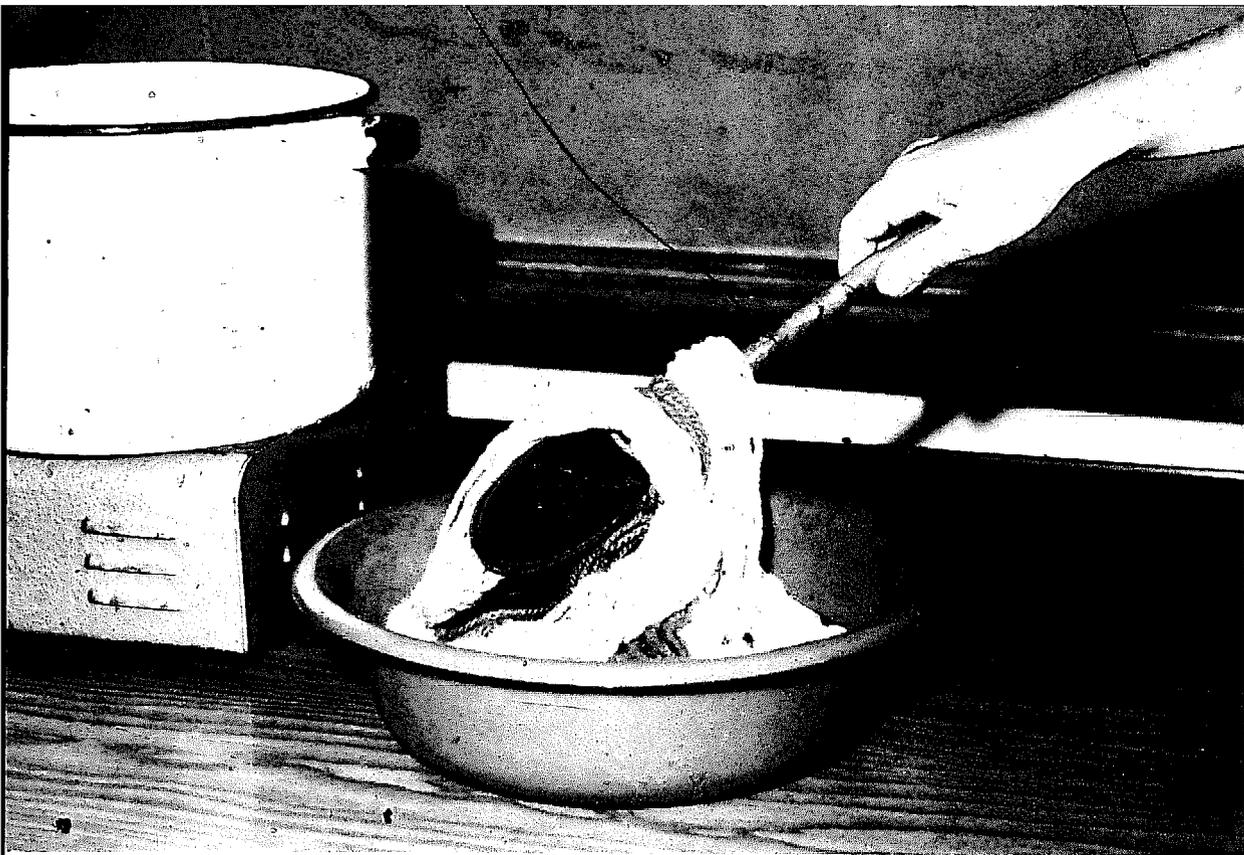
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Photographs by Philip B. Mullan



Above: Skeins of wool are lifted from the dyepot into a container of water of the same temperature as the dyebath as a first step in the rinsing process. Other steps of the dyeing process are shown on pages 10-12.

Left: Carrot tops being cut for dyeing. By the use of different mordants, the resulting dye colors will range from bright yellow through varying shades of greens. For information on mordants, see pages 4 and 5.

LETTER FROM THE BROOKLYN BOTANIC GARDEN

Home crafts have had a revival in the past ten years, as any fair-goer, garden-clubber or book-store-browser quickly notices. More and more people are creating their own pottery, leather goods, patchwork quilts, candles and soaps. Weaving, crewel and macramé are "in," and a rough-and-ready ex-football player, Roosevelt Grier, has even written a book on needle-point. The deeper meaning of this revival we gladly leave to the social "scientists" to ponder, but there is a common denominator that is obvious,—the growing desire for artistic self-expression.

Horticulture is affected too, because creative individuals, often from outside the field, are looking at plants and plant parts as design elements or raw materials. The freshness that accompanies such an approach can only enrich horticulture, since it leads us to look at plants through different eyes. Queen Anne's-lace is no longer a roadside weed but a treasure in a dried arrangement. A deformed pine which would have been discarded from the nursery row a few years ago is now a jewel to the bonsai enthusiast. And the common goldenrod becomes gold to the dyer. (It has never deserved its low reputation with Americans, for in selected forms it is a first-rate, non-aggressive garden perennial, and it is a hay fever culprit only in myth.)

The interest in dyeing with natural plant materials has grown sharply since 1964 when the Brooklyn Botanic Garden's first handbook on the subject appeared. Letters, literally hundreds of them from the United States and other lands, have prompted this companion issue. Let us at this time express our warmest appreciation to Guest Editor Palmyr Weigle and the international roster of Contributors invited by her to share their knowledge of the ancient art of dyeing.

One of the refreshing aspects of the revival in plant dyeing is that it cuts across age lines as well as national boundaries. At a time when much, far too much, is heard about the generation gap, it is noteworthy that young and old are taking an equal interest in this pleasurable craft. But then, the act of artistic creation recognizes no age limits.

If the Botanic Garden has helped in some way to stimulate interest in natural plant dyeing, it has in turn been stimulated by it. Several instructors have caught the "bug," and short courses for adults as well as young people are frequently offered. In this connection it is a pleasure to report that a Botanic Garden color film on plant dyeing, sponsored by the Women's Auxiliary, is available for rental from BBG. Call or write.

Finally, to borrow a thought from Mrs. Weigle: "Happiness is dyeing in your own kitchen!"

Frederick McCounty

Editor

The New York Unit of the Herb Society of America has, by gift, made possible the color photographs in the centerfold of this handbook.

NATURAL PLANT DYEING

A weed in the rose garden may produce a better color in the dyebath than the rosebushes do in the garden

Palmy Weigle

IN the years since 1964 when *Dye Plants and Dyeing* was first published by the Brooklyn Botanic Garden, there has been a transition from the objective intellectual approach to natural plant dyeing to the practical desire to apply the art to one's everyday life. This new approach stems from several factors, including the resurgence of crafts as a whole, the rejection of anything that is not "natural," and the renewed interest in the environment that surrounds us.

In the workshops given at the Botanic Garden and elsewhere, and in the letters that come to us from all parts of the world with increasing frequency, it has become apparent that there are many questions still unanswered and at the same time much information to be shared. It was against this background that a complementary handbook on dyeing was conceived and it is hoped that this issue will stimulate further research.

In discussing the subject of natural dyeing or vegetable dyeing, too often it is contrasted with chemical dyeing. All dyes have a chemical make-up, just as all fibers have a chemical composition. The contrast that is intended is between those dyes that have their basis from objects found in nature as contrasted with those dyes which stem from a laboratory. Dyers throughout history have had a deep interest and a working knowledge of the part that chemistry played in achieving the colors they desired. In order to better understand the nature of the materials being used today, please turn to page 8 of this handbook for a discussion of some of the basic principles involved in natural dyeing.

It is not necessary to work in a laboratory or with highly technical equipment to do natural dyeing. The kitchen stove,

the hot plate in the studio or workroom, or the open fire outdoors can give equally good results. For utensils, enamel, stainless steel or glass pans enable the dyer to bring out the true colors of the material he is using. Lined rubber gloves do help protect the hands from stains and from excessive exposure to some of the mordants.

Mordants are chemical additives that sometimes help a fiber accept a dye that it might previously have rejected. The word "mordant" stems from the Latin *mordere* which means "to bite." It has traditionally been thought that the mordants bite into the fiber to permit the dye to penetrate. From the discussion in this handbook on page 51, it appears that this may very likely be what does happen.

A detailed explanation of the various mordants will be found in *Dye Plants and Dyeing* (Brooklyn Botanic Garden Handbook) on pages 9 to 12. Some of the more common mordants found in the recipes included in this handbook are:

1. Alum (aluminum potassium sulfate), which is usually combined with cream of tartar in a ratio of 3 parts of alum to 1 part of cream of tartar.
2. Cream of tartar (potassium bitartrate), used with alum and sometimes with tin to help soften the effect of those chemicals on the fibers.
3. Tin (stannous chloride), often used as a brightening agent to make a color sharper or lighter.
4. Iron (ferrous sulfate or copperas, not to be confused with copper). In the dye plant world iron is called a "saddening" agent because it makes a color darker or duller.
5. Chrome (potassium dichromate), a bright orange substance that seems to deepen the colors achieved and to make

CHART OF COMMON MORDANTS

Common Name	Chemical Name	As a Premordant in 1 Quart of Water	
		As an Additive Amounts per 1 ounce medium weight 2 ply natural wool	
Alum plus Cream of Tartar	Aluminum potassium sulfate plus Potassium bitartrate	$\frac{3}{4}$ tsp. alum plus $\frac{1}{4}$ tsp. cream of tartar	May be used (in same proportion as premordant) along with wool and dyestuff.
Chrome	Potassium dichromate or bichromate	$\frac{1}{16}$ of a tsp.	Occasionally used (in same proportion as premordant) as an after-bath to aid in color fastness.
Iron (Copperas)	Ferrous sulfate or Green vitriol	Primarily used as an additive to darken or "sadden" a dye bath.	"A pinch"—a small amount held between 2 fingers.
Tin	Stannous chloride	More commonly used as an additive as it can make wool brittle or harsh.	To lighten or brighten a dye bath, use a pinch well dissolved in water before adding to dye bath.
Copper sulfate	Cuprous sulfate or Blue vitriol	Primarily used as an additive—gives wool a light blue or blue-green color.	$\frac{1}{4}$ tsp. dissolved in water.
Vinegar	Acetic acid	$\frac{1}{3}$ of a cup	Frequently used to heighten the color of a dye bath, especially in the red color range.
Ammonia (non-sudsy, clear)	Ammonium hydroxide	Frequently used to draw color out of dye materials especially grasses and lichens.	Whether a premordant or an additive, the amount varies with the different dye material.

Chart by Mollie Harker Rodriguez

them more lasting.

6. Copper sulfate (blue vitriol), often used to help make colors in the green range as it itself imparts a bluish-green color to the fiber.

Other mordants are ammonia (the clear, non-sudsy household type), acetic acid or white vinegar as a substitute of salts as Glauber salts (sodium sulfate).

Are natural dyes fast or do they bleed? These are two separate questions. After a fiber has been dyed, it should be rinsed thoroughly until the rinse water is clear. In this way, all the excess dye is removed

from the fiber and the color will not bleed. Then the color should be tested for fastness (see page 14). If the color does not stay, it is said to be a fugitive color because it flees from the fiber.

The general rule in dyeing is to use soft or neutral water unless the recipe specifically calls for hard water. The material to be used may be mordanted ahead of time or the mordant may be added to the dye bath. Do not subject the fiber, especially wool, to abrupt changes in temperature since this sudden change will "shock" the wool and cause it to lose some of its vitality. Use a mild soapy rinse if



P. W. Grace

Foliage of the sassafras tree (*Sassafras albidum*). The tree's roots will produce a peach-colored dye.

tin or iron has been used as a mordant to help keep the wool from becoming brittle or harsh.

Several colors may be achieved from the same dyebath simultaneously by using skeins prepared with different mordants. To help in identifying the mordants used, attach different kinds of buttons to each skein—for example, round ones for alum and diamond-shaped ones for chrome. From experience in workshops, there does not seem to be a harmful effect from dyeing alum and chrome premordanted skeins with unmordanted skeins in the same dyebath.

Be sure to make and keep notes as to quantity, type of mordant, and other pertinent information. Always label skeins after they are dyed and rinsed, noting the dyestuff, the premordant if any, the additive if any, and the date of dyeing.

It is difficult to duplicate a color exactly, so one should dye all the yarn needed for one project at the same time. The yarn should not be crowded in a dyebath because overcrowding will produce unevenness of dye. It takes approximately one quart of dye for each ounce of yarn. To get the most from the dyestuff, the dyebath may boil vigorously if there is no yarn in the dyebath. Once yarn has been placed in the dyebath, the tempera-

ture should stay below the boiling point. Simmer it not above 190° F. In other words, maintain it at the temperature indicated by little bubbles appearing at the edges of the surface.

Other ingredients helpful for success in natural dyeing are patience, understanding and appreciation. There are dyes that can be achieved readily from gathering the plant material, making the dyebath and dyeing the yarn—all finished in a matter of a couple of hours. These are ideal dyes for demonstration purposes or for classroom work in schools or craft centers. On the other hand, some dyes may take days or even weeks to gain the best colors from them. Too often the influence of the fast pace of life today hinders the development of a beautiful dyebath. If it takes nature 30 years to bring a tree or a lichen to maturity, is 30 days too long to permit a dyebath to ferment to yield its best color?

Natural dyes that are found in the area can often give all the color the dyer desires. Carrot tops, scallions, dried larch needles or privet berries are able to give color. Don't be afraid to experiment.

If there is excitement in seeing white yarn become any one of the colors found in the centerfold of this handbook, the stage has been set for the pursuit of natural dyeing. ♦

COLLECTING AND STORING NATURAL DYE MATERIALS

Palmy Weigle

AMONG the most frequently asked questions at dye workshops are when to gather materials and how to keep them until they are used. There are of course recipes that give specific directions but there are also some general guidelines that apply to most natural dye plant material.

Gather dyestuffs when the part of the plant to be used is at its most vital stage, as described below. The colors will be stronger at that time, especially if the material is used fresh. Be sure to check conservation lists before gathering and always allow Nature the opportunity to replenish her resources.

Roots should be dug in late summer or in autumn after the plant has passed its peak flowering period. Flowers are best picked when coming into full bloom, and berries are collected when fully ripened. Leaves and bark generally give best color if gathered in spring, although bark from trees cut in autumn will still give good color.

If the material cannot be used fresh, remember that it is possible to store many types for later use. Roots, flowers, leaves and bark can be air-dried by placing them on wiremesh in a warm dry place. The wiremesh should be set up so that air can circulate below it as well as above it. The material should be turned over occasionally. In this way the moisture will evaporate more quickly and there will be less chance of mildew. After the material is thoroughly dry, it can be stored in paper bags and kept for future use.

Some berries can be dried and will produce good color. Others will not give the same colors as when used fresh. If a freezer is available, berries can be washed and then quick-frozen in plastic bags or containers. If they are measured before freezing, they do not have to thaw out

before use. Berries that have been frozen properly can give very good results. Other plant parts (flowers, leaves) can be frozen if space is available.

Dyebaths can also be kept for future use. Some recipes suggest that a few days of aging or fermenting can improve a dyebath but a change of color in the dyebath often occurs—sometimes desirable and sometimes not. Storing the dyebath, covered, in a cool place or in a refrigerator is the best way to maintain its stability. Some baths can be frozen with no detrimental effect.

As with many other phases of dyeing, in the absence of specific directions in the recipe, experimentation and experience will be the dyer's greatest asset in the collection and storage of dye plant materials. ♦



P. W. Grace
Bark pattern of American sycamore (*Platanus occidentalis*). Bark of the London plane-tree (*P. acerifolia*) yields a fawn-to-brown dye when alum is added. The American species gives similar dye.

NATURAL DYEING IN THE CLASSROOM

Advice for individual beginners, too—

Mollie Harker Rodriguez

EACH TIME the Brooklyn Botanic Garden offers a course in dyeing with plant materials, among the students are a few instructors in elementary or secondary schools who have come to learn a new craft to use in their own classrooms. Their interest and inquiries, coupled with the Garden's desire to help the individual beginner in this field, have prompted us to share our experience with readers.

Dyeing plants is an intriguing craft. Historically, plants were the main source for the production and manufacture of all the dyes used to color fabrics until the middle of the 19th century. Today a growing number of people are rediscovering this art and are anxious to apply it to fabrics as a substitute for the aniline dyes which are now commonly used.

There are many possibilities here to stimulate the minds of young people. For children, it is learning how to use plants in the same ways as did their ancestors. Experiments in dyeing might accompany work in history or social studies courses, or complement an art course, especially if there is a field trip scheduled to a museum exhibiting tapestries or weavings. Another approach is to include dyeing methods as part of a study of the economic uses of plants.

Collecting the Plants

Collecting the plant material is done when the particular type of plant desired for use is "ready," that is, when most of the dye-producing substances are concentrated in the part you want to collect. Barks and young shoots can be gathered in early spring. Throughout spring and summer there will be leaves and flowers to use fresh or to cut and dry for later use.

In autumn, berries, roots and usually some leaves are available. (See page 7).

The time of collection will alter the colors produced, as will the location of the plant in relation to sunlight, rain, wind, soil and seasonal weather conditions. All of these factors contribute to the character of the plant and therefore to the colors achieved in dyeing. Each time you dye with vegetable materials it is an experiment because every collection of plants is unique. Repeated use of the same dyestuff will prove how varied the results can be.

Wool

Most natural dyes yield more brilliant and lasting colors if used with wool. Wool is animal tissue and due to the substances in its cell walls, the molecules of the mordants and dyes are bound more easily to it than to the celluloid constituents of plant fibers. However, to make comparisons you might add to the dyebath a small piece of cotton sheet or jersey along with the yarn.

For classroom use, 2-ply yarn is very satisfactory because it dyes quickly and is easy to handle. If possible, natural unbleached wool should be used but bleached wool can be substituted if it is more readily available. The yarn should be tied into skeins with white cotton twine for manageability in the dyepot, as shown on page 12 of *Handbook on Dye Plants and Dyeing*. Wash the wool in several solutions of mild soapy warm water and rinse it well before dyeing.

Work with small quantities of wool such as $\frac{1}{2}$ oz. dry weight skeins. They require a minimum of plant material and only a quart or so of dyebath solution. Good color samples can be obtained with

Collecting dahlia flowers to make dyes in the classroom. All flower colors can be used and the flowers can be fresh or dried. Dahlia dye colors are brilliant, ranging from chartreuse to yellows and oranges.



Photographs by Philip B. Mullan

this amount, and then if you want to use more yarn you can dye a larger amount.

In handling the wool during the dyeing process, don't "shock" it at any time by raising the temperature above 190-200° F or by subjecting it to rapid changes in temperature. Always raise the temperature of the wool gradually and lower it in the same manner, and always wet the wool before entering it into the dyebath solution.

You may tie plant material into muslin or old sheeting bags so you won't have to strain it from the dyebath before beginning to dye the wool. The bag can simply be lifted from the pan and discarded with no mess or chance of spilling and burning. Confining the plant material to the bag won't inhibit the dye from entering the solution if the bath is boiled vigorously and the bag is pressed down upon firmly, with a spoon from time to time.

Equipment

A room with a sink with hot and cold water is best for dyeing. In its absence, have a couple of large pails or washpans filled with hot and cold water and an extra empty one for the rinsing operation.

Hot plates or electric burners set on asbestos pads provide the safest means for heat. If the room is equipped with Bunsen burners, use them with stands to

hold the pots above. Keep other hot pads and holders nearby.

Stainless steel and enamel pans are very satisfactory neutral pans for dyeing. They do not in any way affect the dyebath, whereas pans of aluminum and iron alter the colors slightly and shouldn't be used unless that is the desired effect.

Wooden, plastic or stainless steel spoons should be on hand for removing wool from the pots. Measuring cups and spoons are a must, as is a small scale for weighing yarn. Keep some extra plastic dishpans available for use when rinsing and entering the wool. A few glass jars or plastic containers for storing leftover dyebaths may be desirable, too.

Some new dyers like to use a cooking thermometer, but it isn't absolutely necessary. You can tell if a bath is about to boil (at 200° F or so) when little bubbles appear around the edge of the pot. When the wool is in the pot always watch it carefully and reduce the heat to prevent boiling which may damage the yarn.

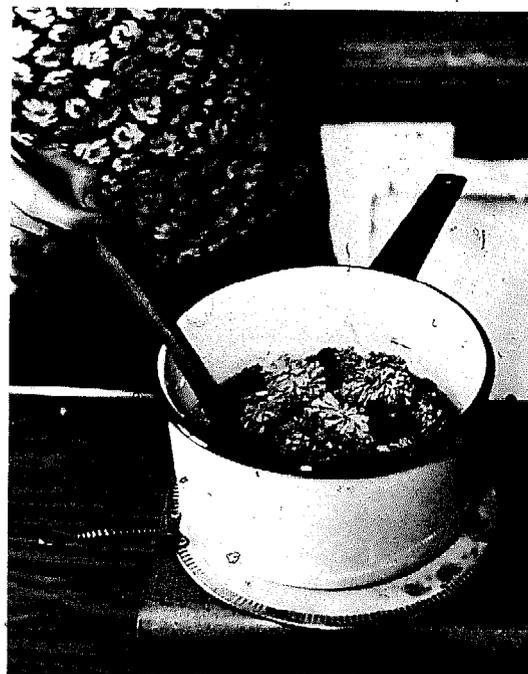
Reserve a place out of direct sunlight where the skeins can be laid on paper towels to dry. Keep pencils and cardboard tags ready for labeling the skeins as soon as they have been rinsed. Labels should include the name of the plant, mordants used, number of dyebaths, date and any other factors which might have contributed to the specific color which



NATURAL DYEING IN THE CLASSROOM Supplies used in classroom dyeing: electric burner, enamel pots, asbestos pad, yarn, scale, sieve, plastic basin, rubber gloves, cotton string, buttons, labels, pencil, measuring cup and spoons, various mordants, wooden spoon, pot holder, thermometer, scissors and dried marigold blossoms.



Dissolving ferrous sulfate (iron) in hot water before adding to dyebath. This insures its even distribution in dyebath.



Dried marigold blossoms are being heated in dyebath solution. Fresh or dried, they give golds or pale greens.



Here marigold flowers are being strained from dyebath solution after boiling. Use marigold leaves for darker greens.



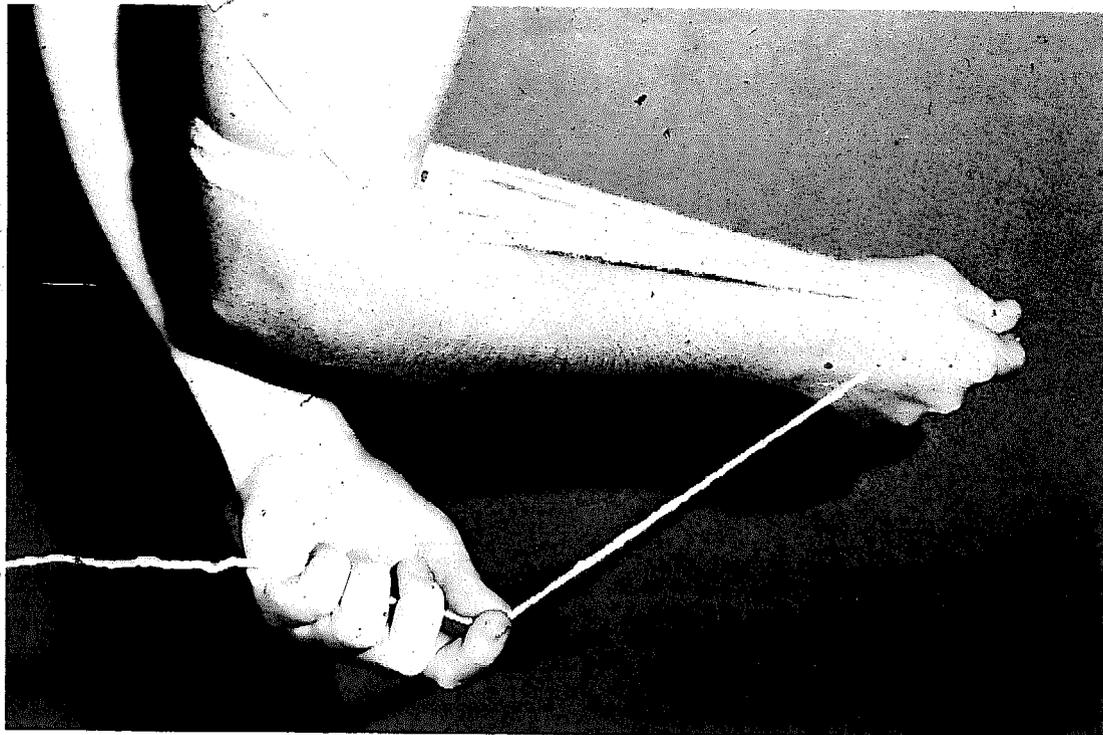
To prevent messiness in a classroom situation, the plant parts used for dyeing can be tied in a piece of old sheeting.



Here skeins of wool are being washed in a mild soapy solution before dyeing. Usually several washes are necessary.



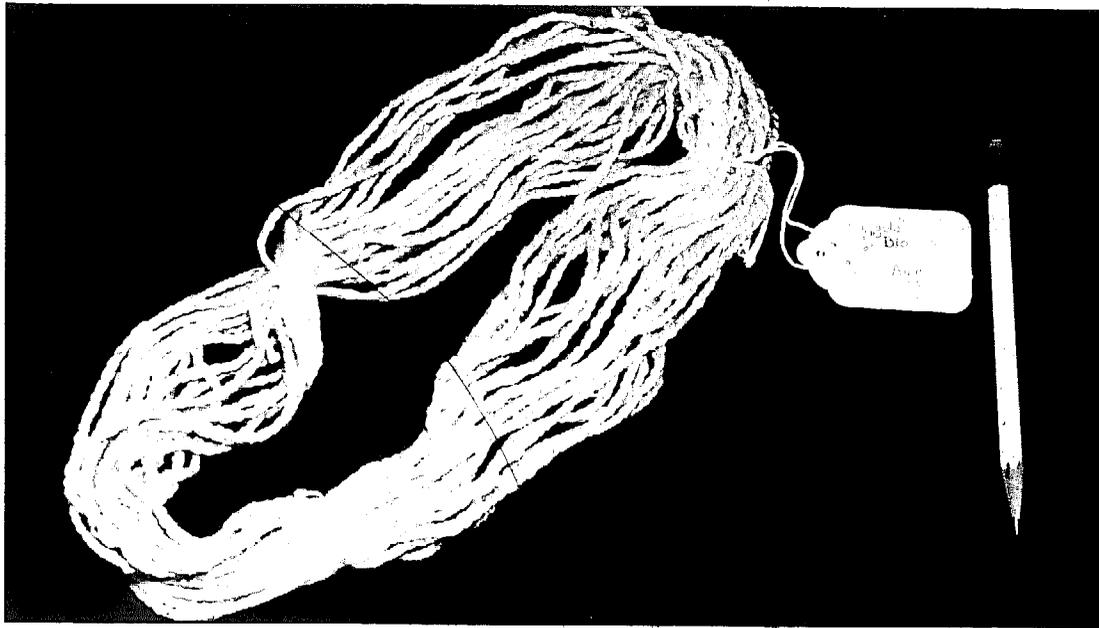
Skeins being lifted from pot to show effect of different mordants. Mordants (chemicals) control final dye colors.



A demonstration of how to wind a skein of yarn around the elbow and hand. The skeins are then tied (see opposite page) and, after washing, inserted in the dyebath.



Skeins are lifted from pot or dyebath after being treated with different mordants and yield different color shades as a result. The yarn at left was treated with alum; the center, chrome; the right, no mordant.



A skein laid out to dry after being dyed. It has been labeled with such information as type of plant and mordants used and date. Note how skein has been tied with cotton string in "figure 8" knots to keep yarn untangled in dye bath.

resulted. It is very easy to confuse samples as soon as the dyeing is completed unless each skein is identified immediately. Keeping careful records on these tags is also helpful in planning and comparing future experiments.

Classroom Technique

Write on the blackboard the recipes you plan to use so everyone in the group can see them. However, if students are to work individually, keep a card with the recipe for each pot at the place where the work is being done.

Depending on the age and number of members in the class, let them do as much of the work as possible. With young children, demonstrate the entire process first, then at the next meeting ask for some help. Since electric burners and hot dye baths are used, it is wise to have another adult as an assistant. Finally, don't allow too many students to work on the same dye pot or too much confusion and excitement may arise.

Children's interest will be greatest if familiar plant materials are used. The best materials are those which they can collect and bring to class. Below are a few

easy recipes that may be applied to a number of materials with modifications possible through the use of various mordants. Information and instruction on mordants will be found on pages 4 and 5 and in Botanic Garden Handbook No. 46, pages 9-13.

Recipe 1

Plant materials to try with Recipe 1: onion skins (red or yellow); flowers of marigold, goldenrod, dahlia, coreopsis, gloriosa daisy (*Rudbeckia* cv.), snapdragon, zinnia, sunflower (*Helianthus*), or cosmos; horse-tails (*Equisetum*); tomato vines; coffee and tea.

Place the dye plant material in a pan with enough water to cover it. Bring to boil and boil vigorously for 30 minutes. Strain out material or remove bag containing it and add enough water to make a solution, allowing one quart for each ounce of yarn to be dyed. (If you wish to combine additive mordants, this is the time to do so. Be sure to dissolve the additive in hot water first and then stir it into the solution before the wool is added.)

Wet the skeins which have been



Gathering gloriosa daisy, a cultivated form of blackeyed-Susan, which results in yellows and shades of green.

prepared for dyeing and gradually change the temperature of the water around them until it is the same as that of the dyebath. Squeeze the excess water out of the skeins and then poke them down into the dyebath solution until they are completely covered. *Simmer*, do not boil, for about $\frac{1}{2}$ hour.

Remove the skeins from the dyepot and place them in a container of water which has been heated to the temperature of the dyebath. Rinse well by using increasingly cooler water until the skeins are cool. Be sure there is no more color coming from the wool. Squeeze dry and place on paper towels to dry thoroughly. Label immediately. (If there is still a good amount of dye in the bath it is possible to incorporate other additive mordants and more yarn to produce a broader range of colors or shades.)

Recipe 2

Plant materials to try with Recipe 2: leaves of rhododendron, lily-of-the-valley (*Convallaria*), bayberry (*Myrica*) or privet (*Ligustrum*); sumac fruits; black walnut hulls; saffrafr roots; logwood chips; oak bark.

Chop up leaves or pulverize roots and barks and soak overnight in enough water to cover them. Bring to a boil and boil vigorously for 45 minutes. Strain out dyestuff or remove bag and add enough water to make a solution, allowing one quart for each ounce of yarn to be dyed. Proceed as in Recipe 1.

Upon Completion

Clean up after each dyeing experiment. Usually a dyebath is "exhausted" (has no

more useful color in it) when the last skein of wool dyed is a very pale shade. There is no reason to save these solutions. However, if no more time is available and a solution still seems quite strong, it can be stored for a short while in a covered container in a cool place. Fermentation of the bath for a period of a month or so may give you a different color you like or may only result in a washed-out shade.

At the end of a workshop for adults it is good to give participants a small sample of all the colors obtained. In advance prepare a sheet listing the plant materials to be used and the basic mordants to be tried with each. Punch a hole in the paper opposite each of these so that at the end it will be easy to tie in a piece of yarn from each sample.

For a children's class it is more appropriate to do a final project together such as making a chart to be hung for reference and display. Use the skeins of dyed yarn and plant materials which yielded each color. Someone might use part of the yarns to make a woven or needlepoint sampler. Be sure to keep the yarns labeled.

Finally, test the yarn samples for fastness. Expose one half of each sample to direct sunlight for a month or so and then compare the two halves to see which colors have faded and which are fast. (See centerfold.) This also could be included in the classroom display.

Enthusiasm will very likely be generated through a child's or adult's first experience with natural dyeing. The basic method of dyeing is not complicated, and a variety of plant materials may be used. Have fun. Go forth and "dye." ♦

PREPARATION OF SHEEP FLEECE FOR DYEING

Edna Blackburn

ONE of the pleasures of natural plant dyeing is that it leads to a better understanding of various allied crafts that were well known to our ancestors but which have largely passed away from the everyday household scene. As a result of the current revival in home dyeing, which has caught the interest of many younger people, hobbyists striving for authenticity often want to prepare many of their own materials. It is possible to do this with wool, particularly in a rural area.

Sources of Wool and Breeds of Sheep

Many countries have wool pools or cooperatives. Your provincial or State Department of Agriculture may be able to help you to find the one in your area.* The fleeces are shorn in the early spring and shipped to a receiving place. It will make it easier if the purchaser has a project in mind and is choosing a fleece for that purpose. For example, a long, staple, coarse fleece, derived from the Lincoln, Cotswold or Leicester breeds of sheep, is selected for rugs. A medium fleece, from Hampshire, Shropshire and Cheviot breeds, is used for sweaters, socks, mittens and blankets. Down breeds, which include Southdown, Dorset and Oxford, or fine woolled sheep* (Merino), are employed for fine garments.

Another way to obtain a good fleece is to find a sheep breeder, know the breed of sheep he raises and purchase directly

*Sources of fleece are also sometimes given in specialized periodicals including *Shuttle, Spindle and Dyepot*, a quarterly publication of the Handweavers Guild of America, 998 Farmington Avenue, West Hartford, Connecticut 06107; *Shepherd Magazine*, Sheffield, Mass. 01257, which gives lists of sheep breeders; *Handweaver & Craftsman*, a bimonthly with offices at 220 Fifth Avenue, New York, N.Y. 10001.

from him. Often in this way you will be able to look at the fleece on the sheep. It should be healthy with lanolin and not webbed. It should also have good tensile strength and a good crimp. If the sheep has been sick or undernourished the fleece could be rotten on the sheep's back.

If possible, the purchaser should know the count system of choosing a fleece, as a double check. The count refers to the number of hanks that can be spun from a pound of a particular kind of wool. The long woolled breeds are usually 30 to 38, medium 40 to 58, down breeds 56 to 60 and fine wools 60 to 120.

Buy the fleece clean. Most sheep men skirt the fleece before rolling and tying. It is rolled with the outside in and the part near the body outside. If buying a rolled fleece, pull a lock and test for general health. The fleece should be shorn in one piece.

Sorting

Take special care in sorting, handling and washing the fleece. First, sort the fleece by laying it on the floor with the exterior of the fleece up. Start sorting from the poorer parts and work up to the best parts. Begin by skirting off the gray and short pieces, then the britch, as it may be stained.

Next, skirt the prime part, which is over the tail. Wind and bad weather may have made it dry and coarse. Proceed to the diamond area in the middle of the back, bearing in mind that it may contain grain and hay dropped on the fleece when the sheep were indoors. This finally leaves the Extra Diamond, which is the best part of the fleece.

Washing and Drying

Soak the unwashed fleece overnight in water as hot as the hand can bear. The next day wash the fleece in small sections

in a clean soap or detergent bath. Avoid an overly sudsy bath mixture because it dries out the fleece by removing much of the natural lanolin. Rinse gently—don't squeeze or wring. Lift the fleece out of the rinse water and let it drain. Handle it gently to avoid matting. If the fleece can be put outdoors to dry, it will fluff up.

Another method is to take groups of locks of the fleece and wash by swishing them in hot suds. The part of the lock closest to the body is known as the head and the outer part is called the tail. Hold the locks by the head and swish the tails in hot suds, thereby releasing the dirt. Then rinse the fleece, spread it out to dry or put directly in the mordant. It can then be dyed. Chicken wire, with large holes, attached to a frame is useful for spreading out the locks to dry in the outdoor air.

This treatment is especially good for down breeds as Southdown or the fine wool of the Merino. Southdown fleece is very short and has much crimp. Merino fleece, which has a fine crimp, is difficult to handle but worthwhile if washed and carded with care.

Color and Thickness

Even though the fleece is taken from

one sheep, its color will not be uniform. For this reason it should be picked over before it is dyed to obtain a more even dye color. If the color of the fleece is still uneven after dyeing, it should be picked again, before beginning the processes of carding and spinning.

If the fleece is to be used for a specific project, decide the thickness of the yarn and how much is needed. The loss in going from the unprepared or "grease" fleece to the washed and dyed fleece is 40 or 50 per cent. Thus, if five pounds of prepared wool are needed, wash ten pounds of fleece.

If a mordant is required for the dye-bath, alum plus cream of tartar is satisfactory because of its mildness. Other mordants may be used to obtain a good range of color even though they may have a tendency to make the wool brittle and tender.

The wool should still have elasticity after washing, mordanting and dyeing. The best utensils are brass, copper, stainless steel, pyrex and enamelware. Be sure of temperature (simmer, don't boil the wool) and of ample room for the fleece to float. Avoid crowding in the utensil as it will not permit even mordanting or dyeing. ♦

Madder Root

TO dye 2 oz. of wool, prepare 4 skeins of wool, each weighing ½ ounce. Premordant 2 skeins with alum and cream of tartar and 2 skeins with chrome.

Place ½ ounce of pulverized madder root (*Rubia tinctorum*) in muslin bag and soak in 2 quarts of water overnight. The following day use medium heat to bring the madder slowly to the boiling point. Let it boil vigorously for only 10 minutes. Remove the madder from the dyebath and divide the dye evenly in 2 dyepots. (The madder root may be used for a second, weaker dyebath later.)

Place the 2 alum-premordanted skeins in 1 dyepot and the chrome-premordanted skeins in the other. Simmer the yarn in the pots for 30 minutes. Remove all the skeins from the dyebaths. Add a pinch of tin to the 1 bath and replace 1 of the alum-mordanted skeins in it. Add a pinch of iron to the other bath and replace 1 of the chrome skeins in it. Simmer each bath for an additional 10 minutes. Rinse all the skeins thoroughly.

The resultant colors: Alum—red; alum plus tin—red-orange; chrome—garnet; chrome plus iron—deep dark red.—*Palmy Weigle*

DYE PLANTS OF THE DEEP SOUTH

Willi and Fred Gerber

THE Deep South of the United States shares a large part of its flora with both the North and the Midwest; however, it has botanical elements distinct from these other areas. Counting the stands of naturalized indigo and the presence of usable wild type cochineal, the dyer can produce from its flora every color without exception.

Lichens

Lichens abound in most parts of the South. The majority respond to boiling water methods but there are also the orchil-producing types, well represented from sea level to over 6,000 feet in the Great Balsam Range of western North Carolina and in the Great Smoky Mountains extending along the North Carolina-Tennessee boundary. The identification of lichens seems fraught with apparently insurmountable difficulties for the uninitiated. For the average dyer nothing equals the keeping of color samples filed with a piece of the lichen responsible for the color and collection data.

A *Ramilina* which has been found in the specialized flora of Florida Indian shell mounds will produce a soft rose color when macerated and subjected to long steeping in a solution of one-third clear non-detergent ammonia and two-thirds water.

Many species of *Cladonia*, which grow in incredible quantities from the sandy pine barrens of the coastal regions to the sphagnum swamps of the mountain tops, will produce a range of soft colors from tans to medium browns by using boiling water methods. *Usnea*, or old man's beard, found in a wide range on trees, shrubs and fence posts, will give much the same colors as *Cladonia* but stronger, sometimes reaching clear golds and rich red-browns in the case of *C. strigosa*.

Some *Parmelia* species give an exciting

range of colors from medium browns to rich rust-reds and even red-violets. There are a few species of particular note. One soft gray leafy *Parmelia*, found in large colonies on the cedars along fresh water streams and brackish creeks along the coast and on the cabbage palms (*Sabal palmetto*), yields rich rust-reds and imparts a delightful permanent fragrance. Another ruffly edged species, somewhat similar to the above and often found in close conjunction with *Parmelia perforatum* on the twigs of the oaks, produces orchil colors with the ammonia method. *P. caperata* gives good strong even browns without reddish tones. *P. tinctoria*, which has been found on the Gulf Coast and is reported to extend northward into Kentucky, is an orchil of outstanding quality useful for deep magenta with ammonia methods.

Equally exciting are the *Umbilicaria* species of high altitudes. *U. pennsylvanica* and *U. papulosa* are found in large quantities generally on rocks that are frequently wet by the mists of the high altitudes. Less often they may be found in the shade of mountain-laurel or rhododendron above 4,000 feet in our lower latitudes. (They grow at sea level in the North.) They produce a rich range of colors from lavender to magenta when used directly from the ammonia preparation or they may be shifted into rose, old rose, cherry-red and rust-reds by the addition of a mild acid to the dye bath.

The orchil bath from *U. pennsylvanica*, if used cold overnight for dyeing wool, gives beautiful intense magentas more brilliant than any others and clearer than if used with heat. Soaking dyed wool in water after rinsing will give a weak dye bath that with heat will dye a soft clear pure pink with no trace of lavender.

Lobaria pulmonaria, known as oak rag,



P. W. Grace

Familiar in the countryside of the North and South in fall and winter are the crimson berry clusters of the staghorn sumac (*Rhus typhina*). The berries yield a khaki dye. Both bark and leaves are rich in tannin.

is generally found on a variety of trees in the mountain areas. This lichen is already well documented for the intense rust-red brown that it will give with boiling water. *Lobaria* may be collected in fair quantity also at higher elevations.

Further south, in Florida, some of the gray crustose lichens on citrus trees will produce bright yellows equivalent to the yellows of *Evernia vulpina* of the West.

Indigo

In a class by itself are the stands of *Indigofera suffruticosa*, remnants in our flora from the Colonial Period when indigo was a commercial crop. It has become naturalized in several places. Where it can be protected from frost it may be treated as a perennial or, where winters are cold, it may be grown easily from seed as a cultivated dyeplant in greenhouses. Indigo blues, therefore, are readily produced here and additional colors are available from the fresh plant. Pinks, lavenders, tans and browns may be had from the dyebath with heat, because the plants contain pigments that are lost in the commercial preparations of the dried product.

The dye is extracted by steeping the

twigs and leaves in water from 12 to 18 hours. Indigo is pH sensitive and may be shifted to bluer colors with small additions of some alkali.

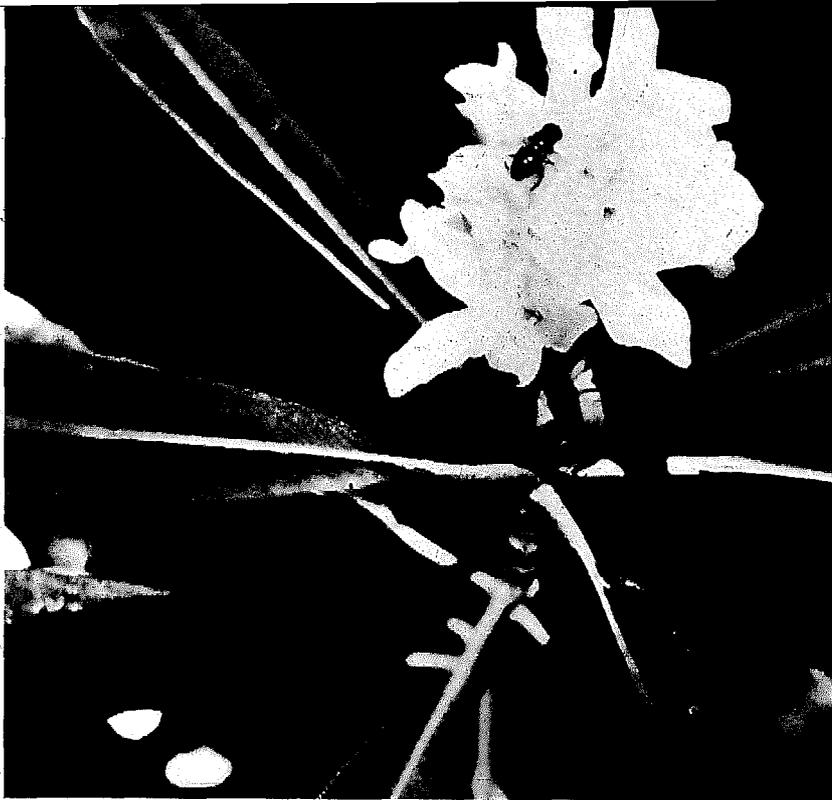
Other Dye Plants

Elderberries (*Sambucus* spp.) are common throughout the South in wet places and along roadsides. The fruit will give soft blues and lavenders.

Yellows may be had virtually everywhere from the annuals, perennials, and the woody elements of plants from both field and garden. Noteworthy plants of the garden for yellows, some greens and less often orange, include marigold, dahlia, zinnia and the onion (skins). Goldenrods (*Solidago* spp.), wild carrot or Queen Anne's-lace (*Daucus carota*) and *Coreopsis* (both annual and perennial species) are all easily cultivated. Butterfly-weed (*Asclepias tuberosa*) and many of the St. John's-worts (*Hypericum* spp.) are used as garden subjects and are good dye plants. Milkweed (*Asclepias syriaca*) is often a serious pest, yet because of its dye qualities should be on every dyer's list.

Other outstanding dye plants for yellows are: *Flaveria linearis*, a composite

The foliage of *Rhododendron maximum* produces rich warm gray shades when cooked with copperas in an iron pot.



which occurs in the brackish soils along coastal waterways; *Bigelovia nudata* and *B. virgata*, resembling a small, semi-succulent goldenrod, found in moist meadows; and various jointweeds (*Polygonella*) of the buckwheat tribe, which give a clear bright soft yellow. The tips of the current year's growth with the leaves and green fruits of the black cherry (*Prunus serotina*) give an incredible range of not only yellows but also oranges. This tree is frequently encountered along fence rows north and south. *Cassia fasciculata* and *C. aspera* both give brilliant intense yellows and produce a dye-bath of unusual strength that can be used more than once for strong colors. Both will also yield "cutch" browns and khaki. Hypericums are already famous for their dye qualities and the South has many woody and herbaceous species. *Chrysopsis* species are excellent not only for yellows but also form a variety of browns and near black. In Florida they bloom most of the winter and provide a source of dye when most other flowering plants are past.

The goldenrods are also well known and seem best gathered just before flowering when the spikes show color.

Gnaphalium obtusifolium, one of the pearly everlastings, a weed of roadsides and open fields, is also good. Beggar-ticks (*Bidens*), especially the adventive *B. tripartita* of wet ditches and swamps, are equivalent to *Coreopsis*. *Coreopsis*, as wild annuals or cultivated perennials, are all among the best. *Coreopsis major* is perhaps the most dramatic herbaceous dyeplant of the Southeast. It produces incredible red-orange colors with alum and ammonia, yellow-orange with alum alone, rust-red orange colors with alum and copper, and strong chocolate brown with alum, iron and ammonia. The noxious weed dog-fennel (*Eupatorium capillifolium*), common as far north as Philadelphia, seems unreported for its dye characteristics. It should be included in every dyer's lists.

The intensities of the yellows of the plants noted above vary over a wide range and may be further modified with additions of tin and tartar or intensified and cleared, if they seem somewhat muddy, by using ammonia in the dye bath for the last few minutes of dyeing or as an addition to the first rinse bath. Many of these same plants with chrome rather than alum produce good brass colors.



The fox or wild grape (*Vitis labrusca*) is a fast-spreading vine of waste places and countryside from New England to Georgia. Its berries yield a purple dye.

P. W. Grace

Many of them with copper or iron sulfate produce greens of a variety of qualities. These greens with ammonia either intensify or shift to tans and browns. In the case of goldenrod the shift can be to excellent blacks.

Various species of *Balduina*, annuals of the southern coastal plain and the Gulf States, occur in large colonies in the poor soils of the pine barrens. They are excellent not only for yellows and brass colors but for icy cool greens if alum and copper sulfate are used.

The grass genus *Andropogon*, in all its many species, ranks among the best and is one of the recognized yellows for bottoming* with indigo for greens. With alum and copper it produces its own greens without indigo overdyeing. *Andropogon* occurs throughout the East either in single-stemmed plants or in large easily collected clumps, according to species. The genus is found along roadsides, in waste places and poor soils. It is superb for drying for winter use.

*Bottoming involves dyeing a second color over a first for a blend. It is a standard method for obtaining greens.

Many of the above plants are also important for orange colors. Special note is made in this respect to the entire group of *Bidens*, to the related genus *Coreopsis*, and to *Prunus*. Some of the colors are intense enough to vie with madder (*Rubia tinctorum*) for honors and many even produce the garnet colors associated with madder. Bedstraws (*Galium*), which are close relatives of madder, are common but the roots are small and the ability to produce the same colors as madder seems more academic than useful.

American mistletoe (*Phoradendron*), mordanted with alum, emerges from the dyebath pallid and poor, until rinsed with ammonia water, when it changes to brilliant yellow. If stored overnight, wet, it often changes to a lovely chartreuse.

The green hulls of black walnut and butternut trees are well known for their intense browns. Hickory hulls can be used for unusual grays of remarkable clarity. Second-growth American chestnuts often produce burrs that have high tinctorial power and also give a variety of browns depending upon the mordants used.

Fetterbush or dog hobble (*Leucothoe fontanesiana*; formerly *L. catesbaei*), especially in late winter, gives unusual and

The seaside goldenrod (*Solidago sempervirens*) is native over a wide area north and south. Its flowers, among the brightest and latest of goldenrods to appear in the fall, yield a lemon-colored dye if an alum mordant is used. With potassium dichromate as a mordant, the color ranges from old gold to tan.



P. W. Grace



Philip B. Mullan

Fresh-cut goldenrod flowers ready for the dyebath. Although the flowers can be used fresh or in the dried state, the brightest dyes result when the flowers are picked just as they begin to open. When the flowers are dried for later use, they open and go to seed, but good-dye colors can still be obtained from these dried parts.

good browns as well as yellows and some greens. *Rhododendron* in the higher altitudes and *Magnolia grandiflora* of the coastal regions will produce good gray colors if the foliage is cooked with copperas in an iron pot.

The red stems of rhubarb, with oxalic acid and tin, give lavender as do the "flowers" (bracts) of the subtropic garden-favorite, poinsettia. Pigweed (*Chenopodium album*), a very obnoxious weed of waste places, roadsides and railway embankments, gives a superb moss green with alum and copper or iron. The fruits of all species of sumac (*Rhus*), cooked with copperas in an iron pot, also give outstanding gray colors. If sumac foliage is also cooked with the fruit in an iron pot with copperas, then good blacks result.

The juice of the ripe fruit of the prickly-pears (*Opuntia* spp.), when slightly fermented and used as a cold dyebath with alum or chrome-mordanted wool, produces unusual pinks and salmon colors of respectable lasting quality. These cacti are common in Florida and one of them, *O. compressa*, has a listed range as far north as Nantucket Island on the northeastern coast.

The high tannin of many of the oaks (*Quercus*) and hemlock (*Tsuga*) may be used with iron sulfate for a variety of grays and blacks. If other pigments are present, tans and browns of great perma-

nence result. Black oak (*Quercus velutina*), known as the source of the dyestuff quercitron, has a range extending throughout the East and as far south as Georgia. Although the bark as a dyestuff is well documented, it is insufficiently known by today's dyers. It is a year-round source of yellows and yellow-orange colors. Southern bayberries (*Myrica* spp.) equal their northern counterparts; sassafras, native to both areas, is famous for its pinky tans.

Cochineal

The *Opuntia* cacti are frequently infested with conspicuous white mats of the scale-covered bodies of the females of the insect *Dactylopius coccus*, cochineal. When enough are gathered all the reds, purples and oranges known for cochineal (see also page 57) may be had. Small quantities yield good intensity dyebaths for limited amounts of wool. Even a weak bath may be used more than once because it is the character of the pigments to be entirely depleted from the bath, given enough time and mordant. The regular cochineal recipes apply.

The wide geographic range of the South with its touches of subtropic flora and a wealth of species offers the dyer an inexhaustible supply of plants from which dyes may be produced. A multitude of species remain to be sampled for their dye potential. ♦

Pokeweed

WASH 1 oz. wool in a good soapsuds, then rinse and simmer it for 1 hour in ½ gallon of water to which has been added ½ cup vinegar. Remove the wool but do not rinse. Now add 2 quarts of ripe berries from pokeweed (*Phytolacca americana*) to the vinegar water and add another ½ cup of vinegar. Boil about 30 minutes. Strain and add enough water to make ½ gallon. Add the wool and simmer ½-1 hour, depending on the shade desired. At no time allow the wool to boil. Keep the bath at the simmering stage and the wool constantly pressed down under the water. Hang the wool to dry. In the next day or two rinse the wool thoroughly until the water is clear. This dye is not fast to sunlight.—Palmy Weigle

BLUE GOES FOR DOWN

How indigo dye came to Liberia—a folk tale

Esther Warner Dendel

IN the long ago and far away when High God left the earth, he went to live in the sky. The sky was close to earth in those days; so close it rested on the hills and mountains and sagged into the valleys. Energetic women feared to beat their pestles too high lest they pierce the fabric of the sky just above their heads and poke the spirit of a departed elder. What calamity!

It was better, really better, that High God, after being whacked a few times by busy women, left the spirits of the departed elders and went higher and farther from people. At least the low-lying sky was left to blanket man and shield him from the fierce sun. The people in their loneliness for God made sacrifices to the spirits of the ancestors and gave them messages to carry to God.

The sky did more for man in those days than to shade him and to house the

spirits. Bits of sky could be eaten. This was different from other foods. Rice and palm oil fill the belly. Sky fills the heart. With a scrap of cloud inside him, a person can float and dream and find again the peaceful, joyous feelings that filled him before High God left the earth.

It was dangerous business, this eating of cloud. One had to come to cloud-food pure in thought and body. Even so, one could become cloud-drunk, sweetly drunk and unknowing. This is what happened to Asi, the seeress of Foya Kamara.

On a bright morning Asi came to the banks of the stream that flows past the town. She came with her girl child tied on her back under a pure white *lappa* of country cloth. On Asi's head was a raffia bag filled with rice which she must cook and eat on the sacred spot where an altar to the river spirit stood against a great silk-cotton tree. In her hands she held a

Indigo leaves have been stripped from their stems in Liberia.

Photographs by Esther Warner Dendel





After the leaves have been collected, they are beaten into a paste. This is a scene in Liberia.

hollow stick. In its hollow was the winking red eye of a lump of charcoal for lighting the sacred fire.

Asi walked calmly, her head high and straight as she neared the altar because one does not rush with unseemly haste to a sacred place. She collected sticks from the forest and lighted the fire between three rocks which held the sacred clay pot which was always left in the forest. After she had spread her *lappa* on the earth and made a cushion of leaves under it to soften the place for her child, she walked without clothes to the bank of the stream where she would rinse the pot and take water for cooking.

On sunny days strips of cloud came to lie down in the river. One could look down into the deep pools and see the beautiful blue color of the sky lying there in the sacred wetness. Asi had eyes and heart that were hungry for color. To Asi, the blue of the pools was the most beautiful color in all the world. Asi looked back at the bank of the stream where her child was lying on the white *lappa*. The color of the white *lappa* seemed a dead and lifeless thing that had never known sun or cloud or sky.

"Perhaps," thought Asi, "if I eat

enough sky, the blue will come to my skin from inside me. With luck, my hair will be thunder-blue."

Asi shivered then because she knew that a seeress must not beg anything for herself at the holy pools; one must ask only for the entire people of the village. She had done a selfish, wicked thing just when she should have been most pure in her heart. Fear shook her body as she carried water for the rice toward the fire. What was done was done, the wicked thought had taken hold of her, she must beg forgiveness of the water spirit and think now of her sacred task.

When the pot of water had been set above the fire, Asi sat with her back against the great silk-cotton tree, waiting for the water to boil. "I will eat some sky now to make my heart lie down and be still," Asi told herself. Reaching up, she broke off a strip of sky as long as a plantain leaf and began to feed her lonely heart.

With the first swallow of sky, beautiful thoughts filled Asi. She felt herself within the roots of the trees far below her in the river-wet soil. The roots nuzzled the earth to drink the holy wetness the way a baby nuzzles a mother's breast to find milk.



A typical indigo vat for dyeing as it exists in Kano, Nigeria.



Also in Kano, Nigeria, scene at a typical indigo dye pit.

Continued from page 24

Asi's own breasts ached with the nuzzling of the roots because her spirit was there inside the sacred roots.

When the roots had drunk their fill and were ready to sleep, Asi's spirit rose and entered the body of a *veda* bird dancing in the air before her. The *veda* is a blue so bright it is a hurting, a lovely hurting to the eyes. It dances in one spot in the air when it is ready to mate. It was from floundering in the sky where the blue rubbed off on its body that the *veda* became this trembling, beautiful blue. Once again, the woman Asi became jealous of possessing this color, blue. She shook herself to try to rid her longing for color. Perhaps if she asked for the blue for all the people, not just for herself. . . .

Asi rose and added the rice to the water in the pot which had begun to boil. She was calmer now and not so afraid since she had decided to make a begging for blue to come down to all the people of Foya Kamara. She saw that her baby was asleep on the white *lappa*. Asi was free to eat just one more bit of sky while the rice cooked. She would then leave her begging for blue along with some rice on the altar and go home before the forest was dark.

When Asi awoke, her head throbbed and she knew she had been drunk with sky. The forest no longer smelled sweet. No birds sang. In her nostrils was the stench of burned rice; she had spoiled the sacrifice she had come to make. The sun was low in the sky. Fear ate at Asi when she turned her aching head to look to her child. The baby had rolled off the *lappa* and was lying face down on the earth. Something strange about the *lappa* caught Asi's eye; there was a blue patch of color in the center where the baby had wet. One small patch of deep blue in the dead expanse of white. Asi did not stop to finger the *lappa*. She rose to her feet as quickly as she could get her joints together and ran to her baby. When she turned the child over, no breath came from its mouth.

Asi's baby was dead. This was the punishment for bringing selfish thoughts to that holy place. In a frenzy of grief Asi ran to the fire, now dead ashes, and loosened her hair to receive the grime of the ashes as is the custom with women in mourning. Tears streamed down her face, streaking the ashes she had piled on her head. Asi clutched her child to her, then wrapped the lifeless body in the *lappa* which was her own skirt. Her body

Indigo

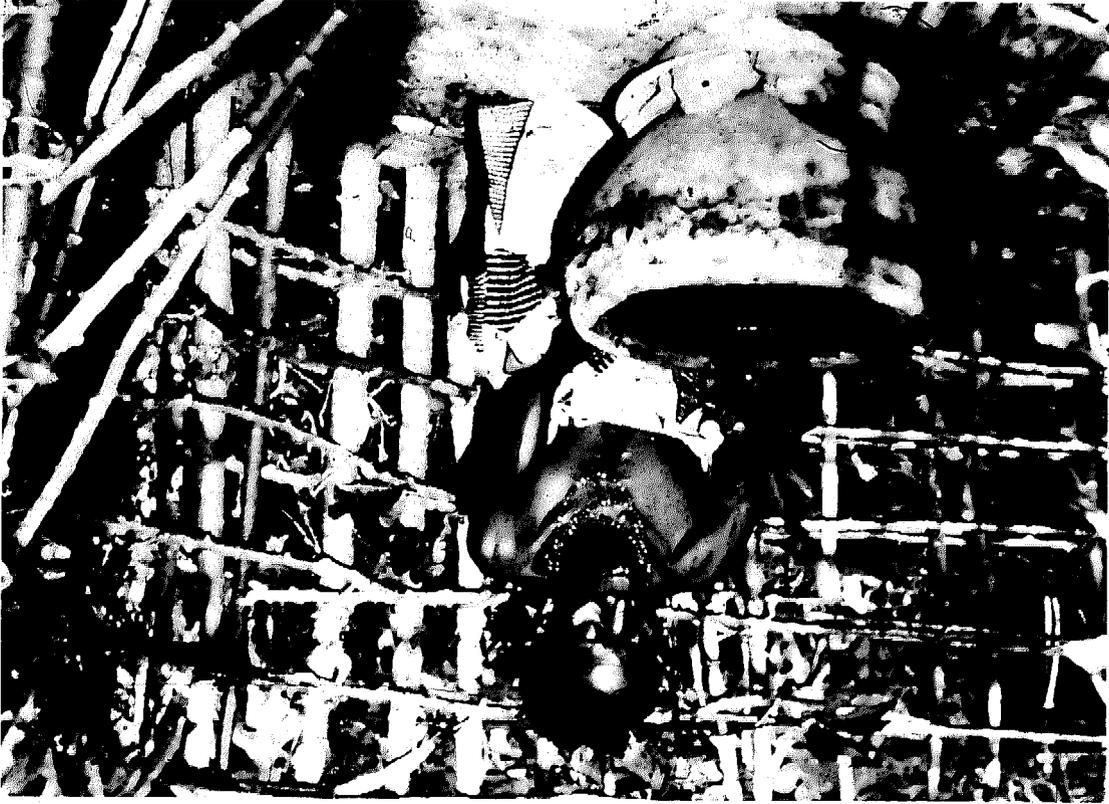
THIS recipe for indigo has been supplied by The Mannings, East Berlin, Pennsylvania. The ingredients are: ½ oz. indigo powder, 1 oz. sal soda (washing soda), 2 oz. sodium hydrosulfite, 1 qt. warm water.

Put indigo powder in a small enamel saucepan. Add a little warm water and stir to a paste. Put sal soda in a measured jar. Add 4 oz. cold water, and stir until the sal soda is thoroughly dissolved.

Add 2 ½ oz. of the fluid sal soda to the indigo paste in the saucepan. Stir and then shake in 1 oz. of sodium hydrosulfite. Add 1 qt. of warm water and heat to 130° F stirring gently. The liquid should show yellow or yellowish green when held to the light. Let stand for 20 minutes and then the dye is ready to be used.

Shake 1 oz. of sodium hydrosulfite over the surface to render harmless any undissolved oxygen. Enter wet skeins of wool in the dyebath for a few seconds. They should be yellowish-green when lifted from the bath and will turn blue as they are exposed to the air. Let dry and then rinse. Repeated dippings will give deeper color.—Palmy Weigle

Scene inside a sacred dye house, also in Liberia.



Balls of indigo are shown drying in the sun in Liberia.



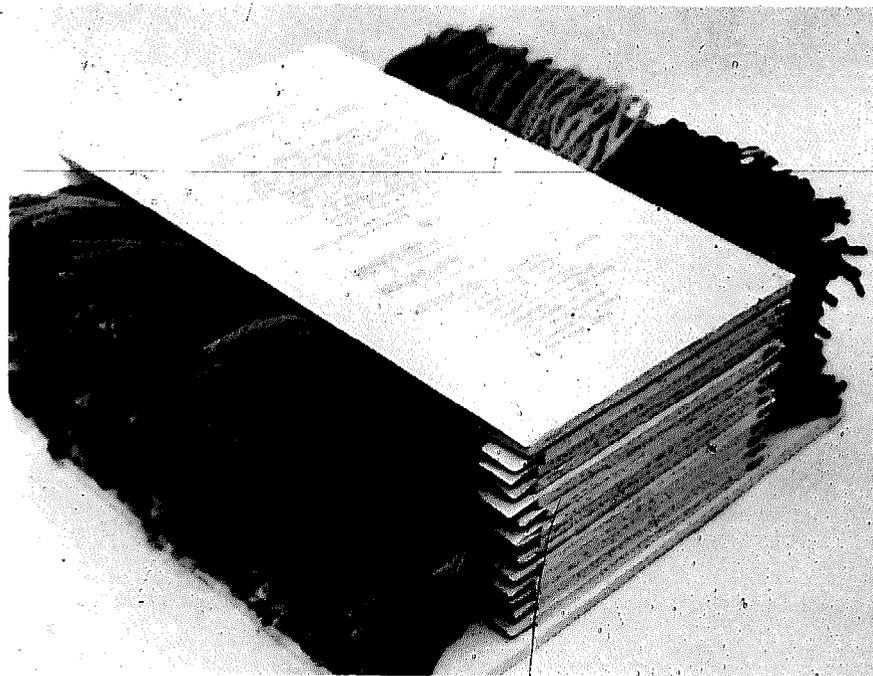
rocked forward and back as she wailed and wept.

Finally, Asi felt the life and the grief going out of her. She fainted there at the base of the silk-cotton tree. And while she was in faint, the water spirit spoke to her, telling her about the blue spot on the white *lappa*. It was indigo, the spirit told her, and came from the leaves she had plucked to cushion her child. In order for the blue to stay, there must be urine and salt and ashes with indigo. It was necessary for the baby's spirit to leave its body; otherwise, Asi would not have added the salt of her tears and the ashes of her grief; the blue Asi had desired above all else would not have stayed on the earth.

Before Asi awakened from this trance, the spirit cautioned her that now since the color blue had come down to earth to

stay, it was a sacred duty to guard the indigo and that only women too old to bear children should handle the indigo pots. Asi was to carry her new knowledge back to Foya Kamara and instruct the old women there how to make the blue juice live happily in the cloth for all the people. Only after that would Asi conceive again and the spirit of her child, just dead, return to live in her hut.

When the people of Foya Kamara awoke the next morning, they saw that the sky no longer rested on the hills or sagged to the roofs of the houses. High God, after having let women have the secret of blue for their clothes, pulled the sky up higher where no one could reach up to break off a piece for food. People look on the blue of fine cloth and have less need of a near sky, even though in their hearts they will always remain lonely for God. ♦



Philip Bergh

A METHOD FOR STORING DYED YARN SAMPLES

Nellie Bergh keeps her naturally dyed yarn samples in this neat file. She has tied a small sample of colored yarn to individual sheets of cardboard which make an even stack. Attached to each sheet of cardboard is a detailed label of the yarn's dyeing history—dyestuffs and mordants used and date.

A PRACTICAL APPROACH TO THE USE OF LICHENS

Phyllis Yacopino

LICHENS contain acids which are easily extracted, creating a broad range of dye possibilities for the home dyer. All lichens have particular chemical characteristics. Once the dyer has a general understanding of how to distinguish the various lichen species, he can follow a basic procedure to extract these acids which in turn can be used for dyeing animal fibers such as wool and silk. Most lichens found locally can be used for dye purposes.

Generally, lichens grow in a wide range of habitats. Heat, sunlight, soil acidity, land elevation, and moisture are all environmental factors which determine where different lichens will be found. Lichens exist under specific conditions from deserts to swamps, from the Arctic to the tropics, growing on soils, rocks and trees.

Lichens provide exciting dyestuffs. Instead of attempting to find the lichens that have already been established as good dye sources it will be more profitable and enjoyable to become acquainted with lichens that are locally accessible. Test these to discover what dyes are available to you.

Characteristics

Lichens are made up of two organisms, a fungus and an alga, with the fungal strands entwined around the algal cells. The alga and fungus live symbiotically. By photosynthesis, food is manufactured by the alga and passed on, in part, to the fungus. The fungus, in turn, provides protection for the alga and may pass on nutrients needed by the alga. In color, lichens range from chartreuse to gray-green or olive to a dull gray or black. Some are a bright orange.

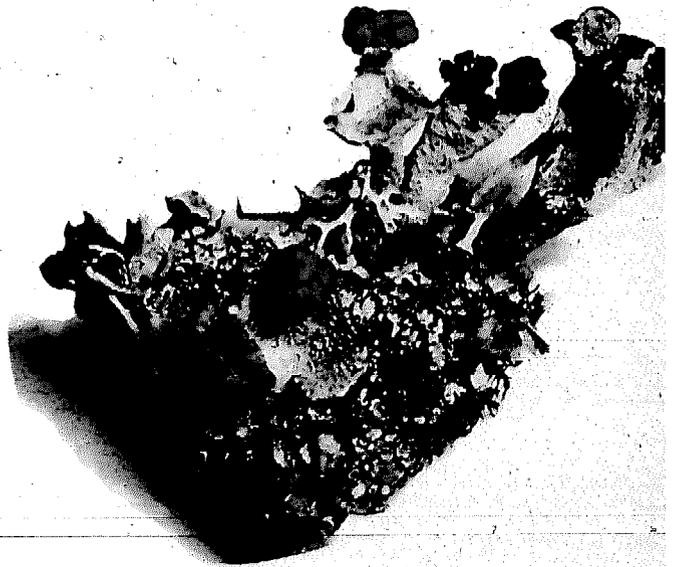
Many lichen features can be recognized with the naked eye, while there are other characteristics that can only be seen un-

der a microscope. For the dyers' purposes we will rely on features that can be readily seen.

Collecting

Begin your lichen study with a field trip. Choose a rainy day or early morning since wet lichens are easier to gather. Take small paper bags for collecting. Avoid plastic bags as the lichens will mold in these, altering their dyeing potential. Bring a knife with a broad tip to scrape them from their growing surface. Carry everything in a large sack.

Go to a place where there are rocks and deciduous trees with low branches. (Lichens on pine trees are hardly ever very large because the bark flakes and much of the lichen is sloughed off.) Look at lichens growing on the ground, especially on banks and near trees. As you begin to notice the various lichens, start to distin-



The lichen genus *Cladonia* is diversified in form and widespread in distribution. Shown here is a cup-shaped species.



Two different kinds of reindeer-moss (*Cladonia*) which are true lichens rather than mosses.

guish them from each other and collect them separately.

Consider their growth forms, color and size, and these characteristics will distinguish various genera and species. Separate the types for possible identification at a later date. Dry and save them until enough are collected for dyeing. A small bagful is adequate for a good sample dye test.

Kinds .

Three growth forms are most apparent among the lichens. *Crustose* ones appear as a fine crust or powder mainly on rocks or bark. Although they have dye possibilities, they are impractical to collect and will be excluded from our concern. The *foliose* types appear leaf-like. In contrast to these are the *fruticose* forms which may have an upright, stemlike growth habit.

With these distinctions in mind, concentrate on the different fruticose and foliose forms. Noticeable size variations may indicate different types. Turn the lichen over and examine the underside that was attached to the growing surface. Foliose undersides are quite different from their upper sides, while less difference is present in the fruticose types. Consider how the lichens were attached to the growing surface. Were they easy to

peel or tightly attached? Were they attached by many connectors or a few? All are structural differences that may help separate lichens. Apothecia, the fruiting structures formed by the fungus, are cup-shaped projections on the upper surface containing the fungal spores. Some lichens may have soredia for propagation. These are aggregations of fungus and algal cells appearing as a powder on the surface or along the borders of the lichen plant body.

Extraction

Once the lichens are collected and dried, the next concern will be to extract their acids. Some acids are easily extracted by boiling as explained below. Since these acids are already present in the lichen, they are often visible by the color of the lichen. Many lichens with a yellow or yellow-green tint often contain usnic acid, and through the boiling method a rust-yellow color range may be derived. The genus *Usnea* itself, a fruticose type, is rich in usnic acid. Most fruticose lichens give good results when boiled. Other colored lichens may impart similar dyes. It is of interest that some mushrooms and other colored fungi can also yield dyes by this same method of extraction.

Other lichens contain colorless acids that need to be reacted upon with alkalis to produce a dye. Ammonia is often used and the lichens are soaked in a bath of it to obtain these dyes. These are historically called orchils. The same lichen may have both dyeing possibilities. (Always use fresh lichens for each test.)

The lichens producing orchils are not obvious by their natural color since the colored dye is actually created when ammonia is added to the acid. However, they may be determined by a simple chemical test. Using a single-edge razor, gently and carefully scrape the top layers of the lichen through the algal layer directly underneath until the white area, known as the medulla, is seen. A quarter-inch patch is sufficient. With a toothpick, place a small amount of household bleach on the medulla. If the white area turns orange, orchil-producing acids are present. The darker the color, the more acid is present. Sometimes certain acids need to be treated with a strong alkali before they will respond to the bleach. If no color is produced with the first test, soak the lichen in a strong alkali solution such as potassium or sodium hydroxide for a minute and then repeat the bleach test. If there are positive results, try the orchil dye recipe below. Many foliose types have orchils. As an example, *Umbilicaria* has large, leathery brown lobes—attached from one point to rocks—and is usually found near running water. The dye obtained here is a brilliant purple. Many other orchils yield blue-red colors.

Preparation

To prepare the lichen for dyeing, remove all debris, soil, moss and bark. Since the acids are inside the cells of the lichen, it is desirable to crush the lichen into a fine powder or to at least bruise or tear it for best results. Weigh the dried lichens to determine the quantity of wool to dye. For an experiment in colors, it is best to use one-half the weight of wool recommended in the recipe for the first bath and then make consecutive baths for lighter tones, until the dyebath is ex-

hausted.

Use neutral pots and equipment such as stainless steel, enamel, ceramic, plastic or glass to avoid metal reactions that may alter the color.

To avoid confusion on the actual lichens used, number the different ones as well as the wool and dyebath. If precise identification seems important, an identical numbered specimen of the uncrushed lichen can be submitted to the biology departments of most state universities. Readers who wish to learn more about the identification of various kinds may also turn to Mason E. Hale's *How to Know the Lichens*, a soft cover edition of which was printed in 1969 by William C. Brown Co., Publishers, 135 S. Locust St., Dubuque, Iowa 52001.

Boiling Water Method—Method 1

Use 1 pound wool to 1 pound lichen.

Fill dye pot with cold water and crushed lichen. Bring slowly to simmer. Simmer 2–3 hours. Leave overnight to cool. Enter wetted wool the next day. Simmer gently to depth of color (1–4 hours). Leave wool in bath until cold. Wash thoroughly.

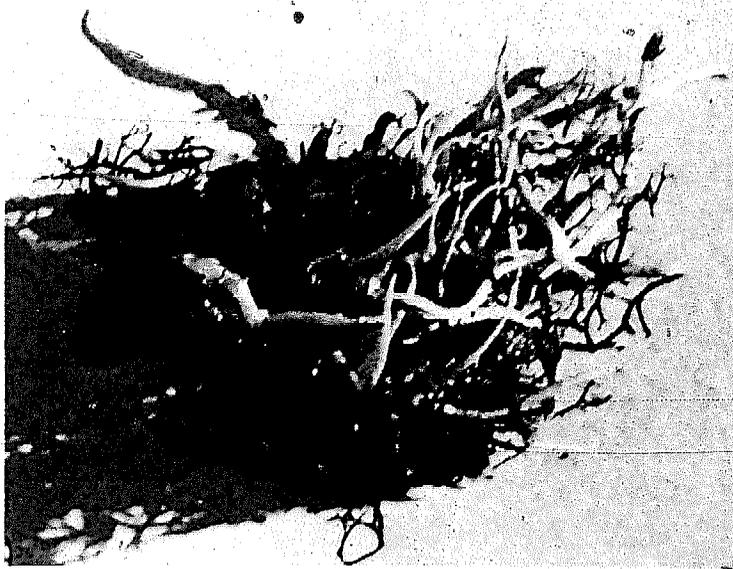
Method 2—Contact Method

Use 1 pound wool to 1 pound lichen. Place layer of lichen on bottom of dye pot, layer of wool, etc., until pot is full. Fill pot with cold water (and acetic acid). (See below.) Simmer gently until the desired shade is reached (1–4 hours). Leave in bath until it is cold. Wash.

Both methods yield good results. The Contact Method is more expedient and the same results are achieved.

Suggestions

Add 1 tsp. acetic acid per pound wool or 4 drops per ounce with the lichen to simmer 1–4 hours. Add premordanted wool with alum, chrome or tin. Leave wool in bath for 2–3 days. Take yarn out at different stages of simmering for a range of shades. Add caustic soda for change in color. For dyeing linen, premordant the yarn in alum for 2 hours and dye for 4 hours.



The worm lichen (*Thamnolia vermicularis*) is a stalked lichen, conspicuous for its very white color. It is found only above timberline in the White Mountains, Adirondacks and northern Rockies.

Orchil Extraction

Use 1 pound wool to $\frac{1}{8}$ — $\frac{1}{2}$ pound lichen. Cover powdered lichen with 1— $1\frac{1}{2}$ parts household clear ammonia to 1 part water. Add enough solution to keep the lichen saturated and well covered by liquid. Cover container to avoid strong fumes from escaping. Add more solution as it evaporates, always keeping the lichen bathing. Keep the fermenting lichen in a warm place (60-75° F) as the fermentation will occur more quickly. Stir solution daily. Ferment 3—28 days.

Orchil Dyeing

Add fermented lichen and liquid to dyepot. Add enough water to make dye bath. Add wetted wool. The wool may dye by sitting in the dyebath for 3 days or by simmering until depth of shade is reached. The color is lighter without heating, but the brilliant purples are destroyed by simmering during the first dyebath. For the best results enter wool to a cold dyebath and raise to simmer as slowly as possible (1—3 hours). As soon as dyebath reaches 195° turn heat off and let the wool sit for 1—3 days in dye. Rinse thoroughly and continue to use the dyebath for lighter tones.

Suggestions

Dye can be used as soon as color runs strong, although the color will be darker and dye more wool the longer it ferments. Use fermented dye diluted by a water bath or let the solution evaporate. (Use 2 oz. wool to 1 tbs. powdered dye.) Add caustic soda for bluer shades. Add acetic acid for redder tones. Use premordanted wool, especially with tin to make dye more permanent in many cases. Wool may remain in the lichen dyebath for several days because the lichen acts as a softening agent and the dye can be more stable.

Dyes extracted by the boiling method are usually quite permanent. Orchils often fade when exposed to direct sunlight. Other than this extreme situation, orchils may remain brilliant indefinitely.

Lichens are abundant in many localities and are easily accessible dye sources, offering an extraordinary range of colors. Once the dyer becomes conscious of their presence and beauty, it should be stressed that lichens grow only millimeters per year. In fact, a good-sized community may take fifty years to develop. Always leave as many lichens as you collect from a given place so they may replenish themselves. Use them with discretion as a fellow conservationist. ♦

PERMANENT COLORS
FROM PLANT DYES
OF ANCIENT USAGE

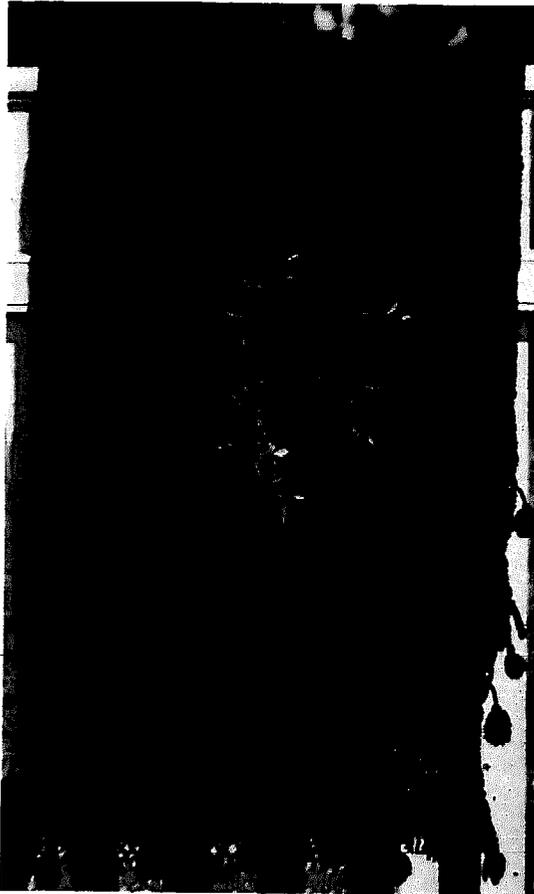


Silk (left), wool (right), dyed with weld (*Reseda luteola*); a weld plant in flower.

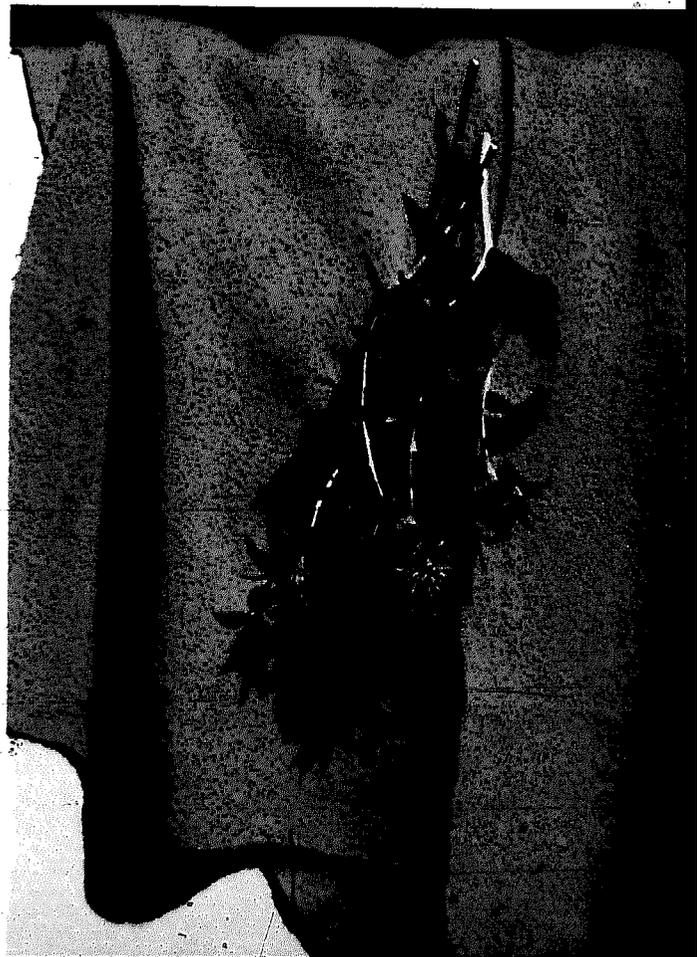


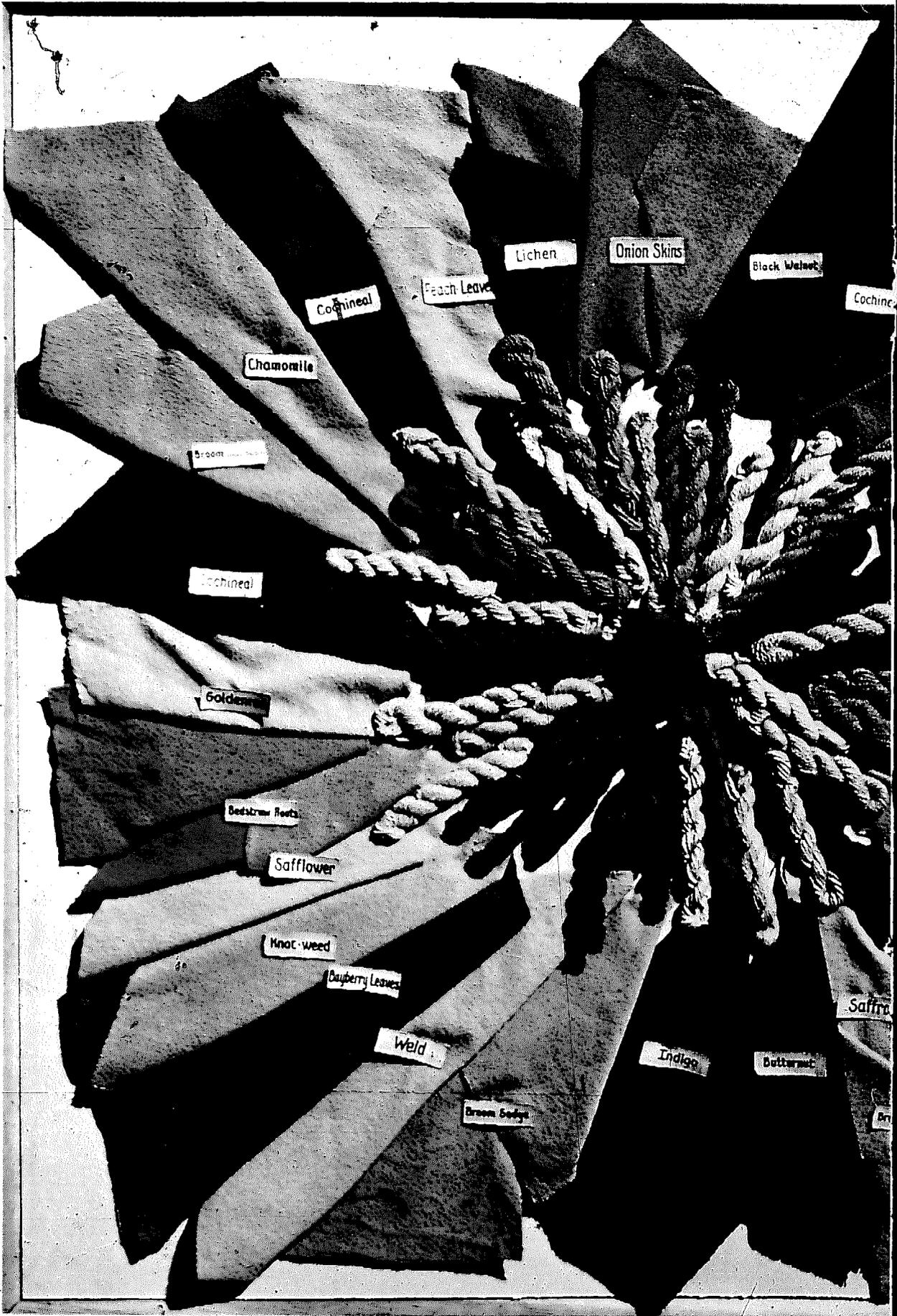
Wool dyed with indigo (*Indigofera tinctoria*), a dye plant first used forty centuries ago.

Woolen scarf dyed with roots of madder (*Rubia tinctorum*), the best vegetable source of red.



Wool dyed with safflower (*Carthamus tinctorius*). Safflower can also be used on silk.





Lichen

Onion Skins

Black Walnut

Cochine

Peach Leaves

Cochineal

Chamomile

Broom

Cochineal

Goldenrod

Redstem Roots

Safflower

Knot-weed

Bayberry Leaves

Weld

Brown Sedge

Indigo

Saffron

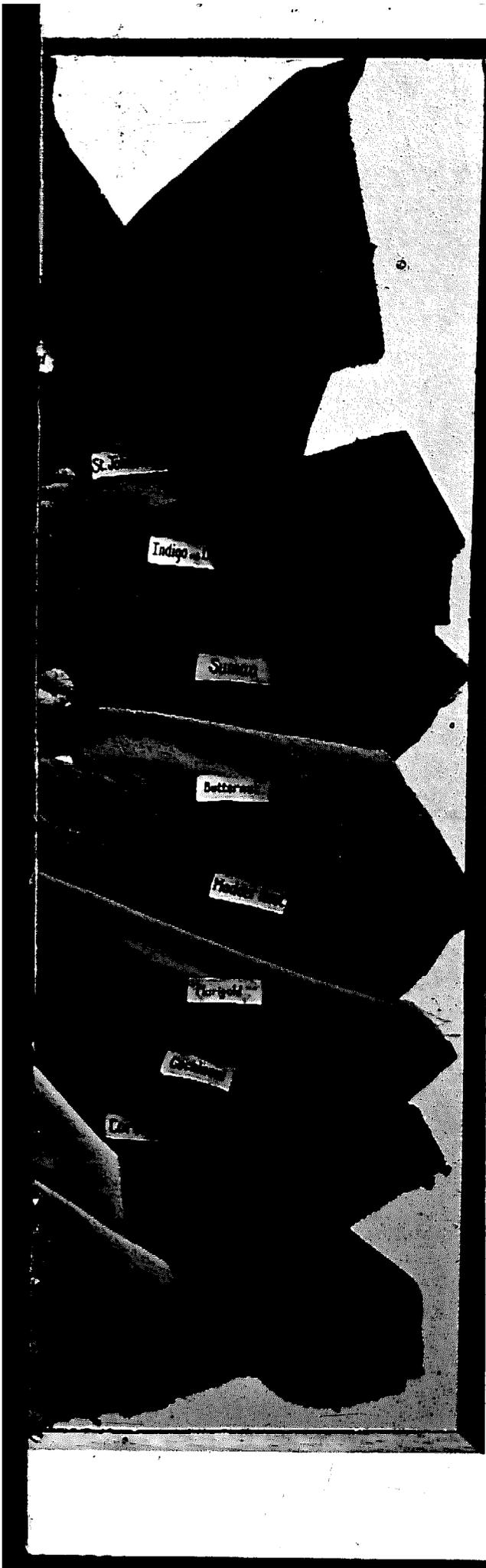
Saffron

Saffron

RANGE OF COLORS
OBTAINABLE FROM
NATURAL DYES ON
WOOLEN YARNS
AND FABRICS

EXCEPT for cochineal (an insect) plants have supplied all these hues. Madder, indigo, saffron and cochineal dyes are obtainable from commercial supply houses. Some of the plants named here may be gathered from the woods and fields, then dried for later use. Others may be grown in a garden.

Dyed and arranged by E. McD. S.



A CHILD'S EXPERIENCE WITH PLANT DYES

THE YARNS illustrated here were colored in the early 1940's as a special project in the children's program of the Brooklyn Botanic Garden. Colors remain strong after more than three decades. The 14-year-old who did the work achieved varied colors through the use of different plants and mordants.

BROOKLYN BOTANIC GARDEN CHILD'S DYEING PROJECT



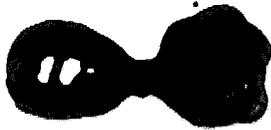
ONION
Alum Mordant



GRAPE AND ONION
Alum Mordant



GRAPE
Alum Mordant



ONION
Chrome Mordant



GRAPE AND ONION
Chrome Mordant



GRAPE
Chrome Mordant



LICHEN



AGERATUM FLOWERS



SPANISH MOSS



DAHLIA FLOWERS



PRIVET LEAVES



SUMAC BERRIES
Alum Mordant



MADDER
Alum Mordant 2



BUTTERNUT



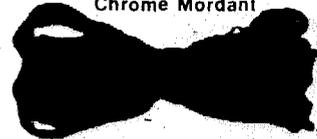
SUMAC BERRIES
Chrome Mordant



MADDER
Alum Mordant 1



BLACK WALNUT



ZINNIA FLOWERS

COREOPSIS FOR REDS ON COTTON AND WOOL

Esther K. Hazel

A COMMON wild plant, a species of *Coreopsis*, grows on wet clay soil in the West, the Canadian prairies, other parts of the United States and Mexico where it was first used as a dye. (*C. tinctoria* is best known to dyers but other species of *Coreopsis* can also be used.) *Coreopsis* blooms all summer. Its flowers can be dried and kept for years in paper bags. After a hot summer, the resultant dye is stronger and more purple.

To dye cotton red: Soak dry flowers for one hour in fresh water. Heat bath quickly until the water feels hot. Then add just enough potash or washing soda to change the color from yellow to red. Pour off the dye into a separate container. Heat flowers again in fresh water adding a little more alkali to dissolve all of the dye. Add this dye into other dye-bath.

The dye produces the best color when a few days old. Wash cotton goods in detergent before dyeing. Cotton material is

dyed in cold solution. Leave overnight in bath, then rinse in water to which a bit of washing soda has been added if the water is not naturally alkaline, and dry the cotton in the sun. When first used, the dye may be orange-red and later purple-red. A little vinegar makes the dye more permanent. More potash should be added to develop the purple in later dyes.

To dye wool: The wool is mordanted first, using alum for orange-red and copper-sulfate for dark-red. Heat the *coreopsis* flowers in fresh water several times, each time pouring off the dye into a second container, and cool. Add the dry wool to the cold dye. Warm the bath and keep very warm until the wool is dyed orange or rust. Potash is added to make the water red. The wool is kept in this bath only until the red develops, then is rinsed in alkaline water and allowed to dry in the sun. Colors are bright and strong. Keep in mind that too much alkali may harm the wool. ♦



Eva Melady

THE SLEEPY HOLLOW RESTORATIONS SHAWLS

An adventure in matching colors

Sylvia Thorne

AT 17th century Philipsburg, Upper Mills, in North Tarrytown, New York and at Van Cortlandt Manor in nearby Cröton-on-Hudson, authenticity is the name of the game. When Sleepy Hollow Restorations wanted a dozen shawls to complement costumes worn by hostesses at these historic landmarks, handspun yarns had to be dyed with natural dyes.

Sample cards of colors possible in Colonial times were contributed by members of the Handweavers Guild of Westchester, whose interest in plant dyeing had originally been stimulated by the Brooklyn Botanic Garden's workshops. Matching the selected shades was the challenge, and the following procedures relate to this task. With few exceptions the recipes used are given in B.B.G. Handbook No. 46.

For mordanting and dyeing the 3 pounds of wool needed for each shawl, an 11-gallon enamel clam-steamer pot was employed. The first sample attempted had been dyed with wilted lilacs. After mordanting with alum and cream of tartar, the yarn was simmered for about two hours with as many lilac-blossoms as the dyepot would accommodate.

To test for a match, the sample was wetted. Then a few strands of the newly dyed yarn were squeezed between paper towels and both examined together in good daylight. After all dyestuff had been abstracted the resulting yellow still lacked substance. The addition of a very small amount of powered saffron produced a good match. The lilac odor even clung to the wool while it was woven.

Marigolds, with an alum mordant pro-

duced an entirely different yellow. Flowers held in a freezer from the previous summer were boiled until the liquor became a dark bronze and then strained out before the wool was immersed. When the desired depth of color developed the yarn was allowed to become cool in the dye bath.

The cost of duplicating a sample originally dyed with saffron proved prohibitive. A substitute was found in the recipe given on page 21 of Brooklyn Handbook No. 46 for dyeing with smartweed (*Polygonum hydropiper*). A bushel of this abundant plant was first dried and used in conjunction with an ounce of powdered saffron.

The only problem in matching a very dark brown by using dried sumac berries mordanted with copper sulfate was that the 11-gallon vessel sprung a leak and dyed the floor too!

Another brown required butternuts at a time of year when none could be obtained. A successful substitute was achieved by boiling madder root until it lost its characteristic rosy hue and turned brown. This time fleece was "dyed-in-the-wool." When dry, however, the shade was too dark. An almost perfect match was finally accomplished by incorporating three light yellows dyed with onion skins and goldenrod. Exact proportions were evenly distributed and blended with a hand-carding machine (two cylinders that rotate against each other and are covered with wire teeth embedded in leather) for a completely even hue.

The indigo shawls presented the most difficulty. A Norwegian recipe called Olium was used. Olium is made by dissolving



Van Cortlandt Manor

The hostess, left, at Van Cortlandt Manor, a Colonial restoration, wears one of the shawls of handspun yarn, which for authenticity, had to be dyed with plant dyes.

powdered indigo in smoking sulfuric acid. A professional chemist procured the acid and made the basic dye solution at a laboratory. Instructions for dyeing with Olium can be found in Edward Worst's *Foot-power Loom Weaving*, available from Penland School of Crafts, Penland, North Carolina, 28765. Briefly they are:

In a glass jar with a tight-fitting top gradually dissolve 15 grams (about 1 tablespoonful) of powdered indigo in 125 grams (a generous water cup) of smoking sulfuric acid. Stir the mixture with a glass rod. Close the jar tightly and allow to stand 24 hours or until needed.

When using Olium, pour a very small quantity—about 15 drops for a medium bright blue—into a glass measuring cup of cold water before adding to the dye-bath. (Never add water to the Olium as it may effervesce dangerously.) Slowly add the mixture to a dyebath of tepid water and immerse the wool at once. If the water is hot the wool will be streaked and clouded. Stir quickly and keep it in motion until the boiling point. The amount of Olium determines the shade. After many experiments with indigo, urine is still the simplest solvent to use, and to quote Norman Kennedy, the Scot who produced splendid blues at Colonial Williamsburg, "It's the cheapest."

The leaky clam-steamer had to be replaced by a baby bath, also made of enamel. It held only 4½ gallons, which meant that for three shawls three sepa-

rate batches had to be dyed-in-the-wool, none of them being exactly alike. Another problem arose because the fleece selected had come from sheep grazed on an island off the Maine coast, which is well known for its salt spray and fog. The indigo refused to penetrate all fibers equally and left a few patches of white. After carding the fleece, the color was slightly muted. But it was still an attractive unmistakable indigo.

The belated acquisition of a large copper clothes boiler made it possible to piece-dye the rest of the shawls after they had been woven.

Two shawls were dyed with cochineal, an important natural dye for hundreds of years and still in commercial use in the 20th century. Though not a plant, cochineal is derived from insects dependent upon species of cacti, particularly *Opuntia coccinellifera*, which is cultivated in Mexico and Peru for this purpose. (See page 57.) A rich rose was obtained with a mordant of tin and oxalic acid. One interesting result of using warp and weft yarns from two different animals was two dissimilar, but harmonizing shades, proving that no two fleeces will dye the same and should always be blended for complete uniformity.

Obviously, exact color matches from different dye lots are never quite attainable. But with determination and a little ingenuity it is possible to come satisfyingly close. ♦

The Rowan-Tree

THE European mountain-ash (*Sorbus aucuparia*), known in many parts of the world as rowan-tree, is one of the native trees of Sweden. American gardeners grow it primarily for its conspicuous orange-to-red fruits, which ripen in autumn and are often eaten by birds. Astrid Swenson reports that the fruits can be used as a dyestuff. With alum and cream of tartar as a mordant, and cooled in potash water, a greenish-yellow dye results. If chrome is used as a mordant and there is no cooling in potash water, the color will be light grayish-brown. Chrome, with iron and alum added to the dyebath for the last 15 minutes, produces a dark grayish brown. Also, a decoction of the ripe fruits is an excellent base for getting a very bright red with both madder and cochineal.

A SUBSTITUTE FOR A TRADITIONAL DYESTUFF

Miriam B. Hewitt

NOW that cudbear,* a traditional dyestuff, is difficult to obtain in the United States, it is helpful to know that a substitute is available within the boundaries of our own country. Certain orchil-producing lichens, when dried following maceration, yield a dye that appears to be similar to cudbear in all its coloring properties.

The dry orchil dyestuff used in our study was prepared from the lichens *Umbilicaria proboscidea* and *U. mammulata (pennsylvanica)*. They were collected at high elevations near Livengood in interior Alaska, where they intermix on rocks fully exposed to the long hours of summer sunshine. Both lichens may also be found in the boreal regions of the Northeast and the Northwest within the continental United States.

It appears that orchils prepared from *U. papulosa* and *U. mammulata*, both of which are more easily identified and more widely distributed in the eastern U.S., dye with no more than subtle differences. However the *U. mammulata* orchil is less potent than the others. If it is used, the quantity given in the following recipes should be doubled.

Preparation*

In preparing the *Umbilicaria* dye substance, the lichen was rubbed through a kitchen strainer to break the lichen into very small particles at the premaceration stage so it would be closer in form to the

familiar cudbear powder when dried four weeks later in the final step. A kitchen blender will grind dry lichens into particles at least as fine as those produced by rubbing them through a strainer. One need only rinse the blender with a small portion of the ammonia-water solution to recover the dust, adding this first to the maceration.

When the lichen had been pulverized it was transferred to a jar, wetted with a little water, and then saturated to a stirrable consistency with a solution of one part non-detergent ammonia and two parts water. The jar was kept lidded in a warm spot except to stir the contents several times a day until the color ran. Stirring occurred less often thereafter. At the end of four weeks the macerated lichen was transferred to a glass bowl and dried at a uniform rate by mixing when necessary as the liquid evaporated. When thoroughly dry the orchil dyestuff had the appearance of very dark coffee grounds. It was considerably more granular than cudbear powder.

This dry orchil dyestuff, used in its granular form and without the addition of any other compound, produces a purple-red color similar to cudbear in value and intensity. Both dyes can be modified to the same colors by changing the pH of the dye bath through the addition of acetic acid or ammonia, and both dyes seem to be equally fugitive. In conducting the preceding investigation, one tablespoon of the dyestuff (one tablespoon of the dry orchil weighed 5.5 grams) was used in one gallon of water to dye 4 ounces of wool a color of medium value. In each case the dyestuff was soaked in a cup of hot water before it was added to the dye bath, and the wool was simmered for one hour and then cooled in the dye bath.

In extending the comparison between

*Cudbear is a prepared combination of the lichens *Ochrolechia tartarea* (a later substitute was *Umbilicaria pustulata*), *Ureolaria calcarea* and *Cladonia pyxidata*. It was patented in 1758 by a Scottish merchant, Cuthbert Gordon, who named it for his mother. See Rita J. Adrosko, *Natural Dyes in the United States*, p. 44.



Phyllis Yacopina

Umbilicaria and other lichens are macerated before they are used as dyes.

cutbear and the dried native orchil, traditional combination dyebaths were prepared of madder, cochineal and logwood. One bath of each of the above contained cutbear; a second contained an equal amount of the native orchil instead of cutbear. Following the same procedure, the dyed specimens were so alike in hue and intensity that only minor differences in value enable one to conclude the specimens did not come out of the same dye pot.

Recipes

The recipes given here are for one pound of wool premordanted with alum and cream of tartar.

madder root: 8 ounces
orchil: 1 ounce

Presoak the madder and orchil. Add them to the dye bath and stir well as it is brought to a temperature of 180° F. Hold the bath at 180° for 20 minutes before adding the premordanted wool, and then dye at the same temperature for one hour. Rinse thoroughly and then pass through a boiling soap bath. Color: deep red-orange. The orchil reddens the orange produced by madder alone.

cochineal: 2 ounces
common salt: 1 tablespoon
orchil: 1 tablespoon

Presoak the cochineal and orchil and dis-

solve the salt. Stir these into the dye bath, add the premordanted wool and bring the dye bath slowly to simmering. Simmer one hour and cool in the dye bath. Color: crimson. The orchil blues the red produced by cochineal alone.

logwood: 3 ounces
orchil: 1 ounce

Wrap the dyestuffs in cheesecloth and simmer in a small pot of water to extract as much color as possible. Add this liquid to the dye bath, stirring well. Add the premordanted wool and simmer for 30 minutes. Color: purple-red. For a navy blue, add $\frac{1}{4}$ cup of ammonia to the bath at the end of the dyeing; for purple, brighten with tin.

Summary

It appears that one of the most practical uses of our native orchils could well be in these mixed dye baths. The colors are rich and distinctive enough to warrant attention, and they do not seem to lose their initial color under normal fading conditions. Further study may show that orchils prepared from other indigenous umbilicate lichens behave the same way in these mixed dye baths; and it would be interesting to explore the blooming properties of native orchils in other red and blue dye baths. ♦

COLOR IN ICELAND

Astrid Swenson

HALLDÓRA Bjarnadóttir, the grande dame of Icelandic crafts, has written a beautiful book on weaving in Icelandic homes. It is called *Vefnadar* (Menningarsjóds Publishers, Reykjavik, 1966).

Halldóra mentions that in Iceland all dyeing of yarn is done in the homes but that the natural colors of the wool are used very much for everyday wear. Many pictures in her book show how the whites, grays, browns and blacks give fine color variations to woven articles.

Since black wool is in great demand for clothing in Iceland but the supply of naturally black wool is far from sufficient, the Icelandic women carried on a long struggle until they found a way of dyeing a good black by using their own native material.

For many years something known as "the black plant" (*sorta*) was tried, but the color rubbed off. Black mud from the bogs (*sorti mutti*) and also bearberry (*Arctostaphylos uva-ursi*), which is called *sortulyng* in Icelandic, were used for some time. They yielded a black dye, but it was neither deep nor durable. Finally it was discovered that the combination of black mud and bearberry gave a beautiful and fast black color.

G. G. Nearing

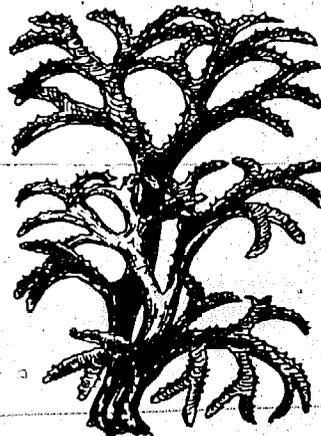
The Iceland-moss (*Cetraria islandica*), also called "mountain-grass" in Iceland, is widely distributed in northern countries, including the northern United States. It is a paper-thin lichen, brown to gray, olive-green when wet, and is found on both soil and rocks in tangled masses. Beyond its use in dyeing, according to G. G. Nearing in his *The Lichen Book*, this lichen has been important as food for humans and animals.

Indigo has been imported to Iceland since the early 19th century for more color-fast and clear blues than any native plant could yield. It is used with urine as a mordant in the old way, even though in most other western countries ammonia is now substituted for urine in similar dyeing processes. In Iceland the blue from indigo is called "stone-color."

However, with all these colors, natural as well as dyed, the very important red—"the queen's color"—was missing. Icelandic women had tried for centuries to find a native plant that would give a red color and, finally, also in the early 19th century their experiments led to a discovery.

First, the yarn was boiled with "*fjalla-grös* (mountain-grass)—the lichen *Cetraria islandica*. Then it was treated for a couple of weeks with stale urine from pregnant cows (sometimes with a little of the national strong drink "black death" added to it). The result was what first was called the "cow-urine red," later named "Icelandic high-red." The color is bluish-red, "the true scarlet."

Final note: In Sweden *Cetraria islandica* is used with alum-mordanted yarn and an ordinary dyebath for yellowish-brown colors. ♦



A DYEING PROJECT IN SWEDEN

Astrid Swenson

LAST summer during a visit to my native country, Sweden, I traveled back and forth through the countryside visiting relatives and friends, and at the same time conducted a kind of dye plant workshop for myself. At first I followed given recipes, then started to experiment with chemicals and with plants of my own choice.

Wild fruits such as blueberries, black currants and lingonberries are plentiful in Sweden. They proved to be a wonderful source of dyestuff even though I learned later such colors are not considered to be very fast. I also discovered that there are many interesting old (and even some new) methods of dyeing that should not be forgotten. Although they seem to be only locally known, the same ones may very well be found in other parts of the world with slight variations.

St. John's-wort

St. John's-wort (*Hypericum*) has been the subject of religious as well as medicinal beliefs since heathen times. It has been used in brewing beer and aquavit, also as a source of red for coloring yarns. The color depends mainly on a tiny, intensely dark violet gland on the anther, which contains a reddish-violet fluid which dye fingers red if the buds and flowers are crushed with the hand.

There are about 300 species of *Hypericum* in the world, seven of them growing in Sweden. *H. maculatum* and *H. perforatum*, in that order, are the best for dyeing. (*H. perforatum* is now widely naturalized in the eastern U.S.). Although the roots and other parts of these plants may also be employed for dyeing, it is mostly the clusters of buds and flowers that are used, with a tin mordant, for red. Even late summer flowers, when dried, give a brownish red color to yarn mordanted with alum and cream of tartar.

The famous Swedish naturalist, Professor Anders Retzius (1742-1821), mentions in his *Flora Oeconomica* that the flowers of both *H. maculatum* and *H. perforatum*, when boiled with alum, give a "rather beautiful but not altogether fast red color." He added that they give yellow if alum and potash are used, while tin dissolved in aqua regia (1 part nitric acid to 3-4 parts hydrochloric acid) will result in "shades of rose, cherry and crimson red."

Yellow for Linen

Some of the finest linen in the world is to be found in and around Angermanland, one of the northern provinces of Sweden. Soil and climate there seem to be perfect for flax (*Linum usitatissimum*), and as far back as is known, people on the farms grew flax for their own use. Many still do.

Because of the difficulties in dyeing linen, bleaching is the technique most frequently used. However, last summer when I visited my sister, Eva Varlenius, up north in Härnösand, she had rediscovered an old way of letting nature cure the flax yellow.

In the shade on the north side of the house, Eva put twenty "steps" (handy bundles of flax) side by side in a long row on the grass. In two or three weeks the combination of the moisture from the ground, the radiation from the sky, the dew during the nights and perhaps some rain was supposed to change the color from flaxen to warm yellow. She rolled the "steps" over a quarter of a turn each day and, sure enough, after ten days the flax started to have a certain glow, and it grew more golden each day.

Green for Linen

While I was visiting Härnösand, the local historical society arranged a crafts-

The European birch (*Betula pendula*, formerly *B. alba*) is a popular tree in many northern countries. Its leaves yield a creamy yellow when used with alum as a mordant.



P. W. Grace

man's day at the open-air museum, Murberget. Now I was to experience a second surprise concerning home-dyed linen. On a table in one of the old log cabins was a display of tablecloths, all woven in damask and made by women living in the area. All the cloths but one were woven in natural and/or bleached linen. The exception was woven with a natural warp and a soft green weft.

It was a rainy day but, in spite of the sparse light coming through the small windows, the interplay of light on all the tablecloths was magnificent, and the green one was particularly outstanding. Later in Gēdēa, I visited the woman, Anna Sporing, who had woven the tablecloth which, some years before, had earned her the silver medal at the National Country Fair. She was kind enough to tell me how she had produced the green color:

"I put well water into an untinned

copper kettle on the stove. When the water was lukewarm I added soap flakes and some powdered sodium carbonate. When it all had dissolved I added my skeins of unwashed and unbleached linen, stirred often with a wooden spade and let it slowly come to a boil. After an hour of boiling and frequent stirring, I plunged the skeins directly from the hot bath into a zinc tub containing cold well water. The green color developed while the yarn was still in the cold water in the zinc tub."

Anna's story inspired me to do some vegetable dyeing, using either an untinned copper kettle, or an enamel pot with a layer of copper coins in the bottom, or by adding copper sulfate at the end of the dyeing, in each case using a zinc pail for the first rinse water. Sometimes no change was visible, sometimes the color turned lighter and sometimes the color changed into a darker shade. ♦

THE AUSTRALIAN EUCALYPTS

Jean K. Carman

EUCALYPTS or gum trees, as they are sometimes called (*Eucalyptus* spp.), are dominant features of the Australian landscape. Native to Australia, over 500 species of them are spread throughout the continent. A few also occur in the adjacent islands to the north and on Tasmania.

Eucalypts are adaptable to a very wide range of climatic conditions in Australia. They can be seen as giants in the southern rain forests, as stately trees along the banks of the inland rivers, as wind-twisted specimens of various shapes on the slopes of the Australian Alps, and as sparse, tough little trees of the arid areas.

Some species have been introduced to other countries. They are now flourishing in many parts of the world and are adding something of their own special beauty to alien landscapes.

Five years ago, as a member of the Handweavers and Spinners Guild of Victoria, I overheard two acquaintances dis-

cussing the dye colors they had obtained from "gum" leaves. As the colors were quite different, I decided to test the leaves for dye color from the eleven species of eucalypts growing on our property. From these trees, with alum used as a mordant, such a range of colors was obtained that I decided to experiment further. With the help of family, friends, botanists and especially officers of the Forestry Department, who collected leaves for me, over 130 species of eucalypts from each state of Australia, Papua and New Guinea have been tested.

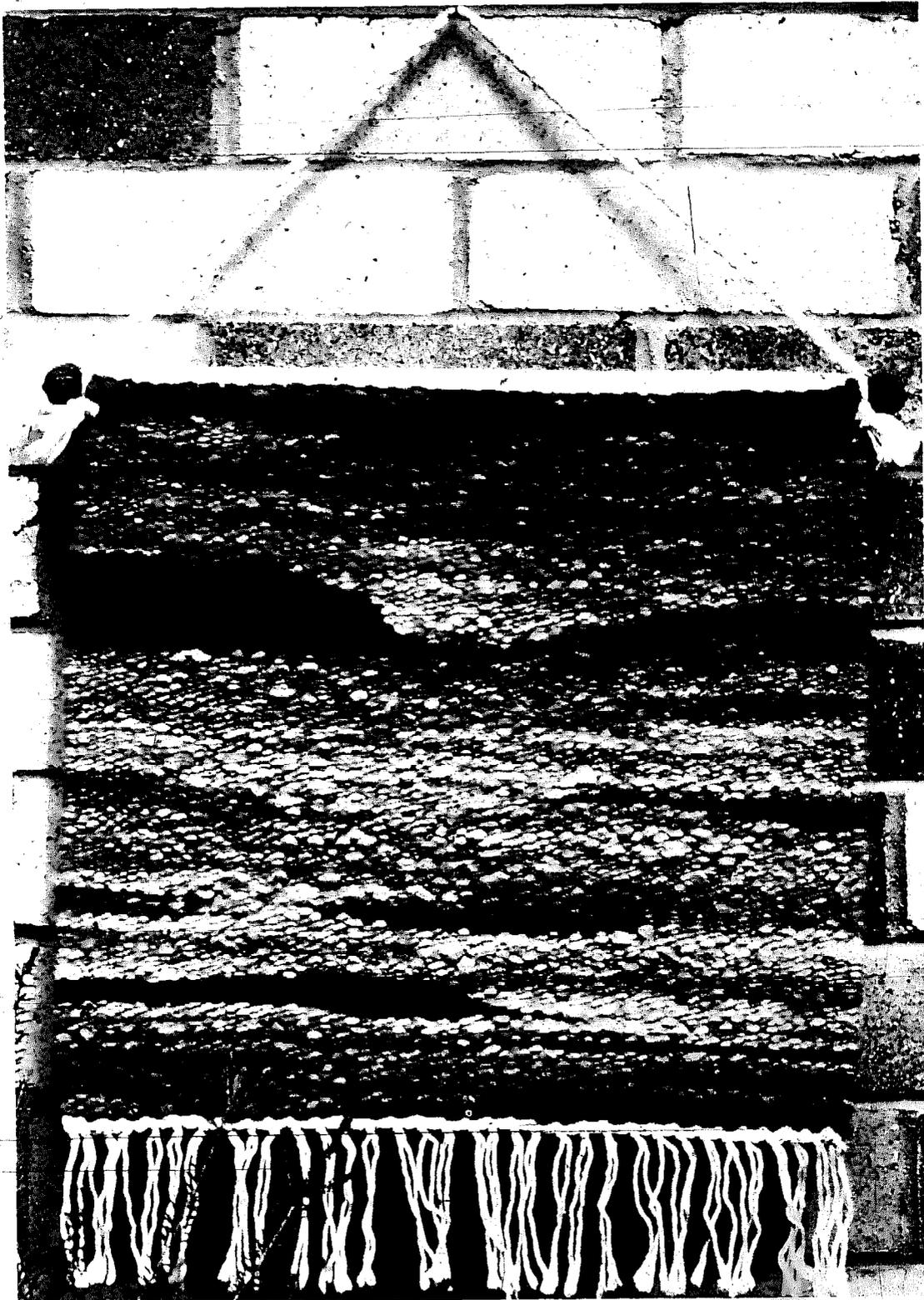
To carry out these experiments, the four basic mordants—alum (potassium aluminum sulfate), tin (stannous chloride), copper (copper sulfate) and iron (ferrous sulfate)—were used. I also employed the standard method for mordanting the wool and adding the wool to the dyebath.

To prepare the dyebath, the leaves of the eucalypts were cut up and boiled in



C. Totterdell

Eucalyptus pauciflora, known in Australia as the snow gum, in Kosciusko State Park.



Jean K. Carman

The author created this tapestry from spindle-spun woollen yarn dyed from leaves of Australian eucalyptus trees. She calls the tapestry "The Sun-burnt Land." It demonstrates the wide range of dye colors possible from these trees.



Left: *Eucalyptus cordata* growing in the Canberra Botanic Gardens. Its leaves give a strong red dye, according to the author.

Photographs by Murray Fagg, courtesy
Canberra Botanic Gardens

rain water in an enamel saucepan with the lid on, for one hour. A longer time is necessary if the leaves are thick, as in the case with some eucalypts from western Australia. Then, the liquid was strained and mordanted wool added.

Throughout the tests the same procedure was used and all weights and measurements were checked. The wool used was Border Leicester. (The finer wool, such as Merino, gives softer, paler shades.) The colors obtained did not fade after careful washing of the wool. Also, exposure to light did not affect them appreciably.

With alum as a mordant, dye colors ranged from red, orange and yellow to olive-green depending on the species of eucalypt used. Copper sulfate gave shades of green and brown, stannous chloride, yellow shades and ferrous sulfate, varying shades of gray.

It is interesting that a whole range of

colors and shades can be obtained from one of the eucalypts, which gives a red dye (see below), by mixing the mordants. Also, black was obtained from two tallow-wood eucalypts, *E. microcorys* and *E. planchoniana*, by using a copper-sulfate mordant and adding ferrous sulfate to the dyebath.

In Victoria the most intense colors were obtained during the hot, dry summer months six years ago but, in less than 24 hours after the drought ended, the dye color from *E. cephalocarpa* (red) and *E. obliqua* (yellow) changed dramatically to much lighter shades. During the wet winter months that followed, the mountain-ash eucalyptus (*E. regnans*) and the snow gum (*E. pauciflora*) were a drab color instead of a clear yellow. I have since learned to obtain a consistent color by drying all leaves before dyeing.

Some species of eucalypts are found growing wild only in certain states of



The juvenile leaves of *Eucalyptus cordata*. This species is native to Tasmania.

Australia. Of those tested, the dye color remained the same, with the exception of the river red gum (*E. camaldulensis*). However, most of the eucalypts tested that have been grown out of their natural habitat produced different shades.

There are few species of eucalypts giving the red dye and these seem to come from the southern half of Australia. They include *E. cinerea*, *E. cephalocarpa*, *E. stuartiana*, *E. tetragona*, *E. cornuta* and *E. cordata*.

At present the strongest red dye I have

obtained comes from *E. cordata*, which is native to Tasmania, and its dye color does not appear to change when the species is grown out of its natural habitat. Even wool mordanted with stannous chloride and copper sulfate will give red shades.

One last note on colors: It is possible to achieve varying shades of brown if the bark of eucalypts is employed. Regardless of shades, the dye colors from the eucalypts are very beautiful and they present a fitting complement to our "sun-burnt" country. ♦

The Florist Eucalyptus

FOR northern dyers who do not have access to the many eucalypts of Australia, the silver-dollar eucalyptus (*Eucalyptus cinerea*), available at the florist shop, offers an interesting experience—and a heady fragrance.

Cut up several stalks of fresh eucalyptus and chop the leaves. Soak them overnight in water. The following day boil the stalks and leaves in the soaking water for about 45 minutes. Strain out the solid matter and use the dyebath with skeins that have been premordanted with alum or chrome. The colors will be yellow and gold. The addition of a pinch of tin to the dyebath heightens the intensity of the colors obtained.—*Palmy Weigle*

PLANT DYEING IN NEW ZEALAND

Joyce Lloyd and Molly Duncan



Photographs by George Bull

Clumps of New Zealand-flax (*Phormium tenax*), an important dye plant in New Zealand. All parts of the plant are used, including a sticky gum from the base of the plant. New Zealand-flax is an attractive ornamental that is featured in many mild-climate gardens.

PLANT dyeing will always remain a dominant feature in New Zealand wool crafts. Conditions for success are ideal. The climate of this agricultural country favors the growth of lush foliage—and the people are skilled plantmen. Furthermore, wool is plentiful and, as most plant dyers know, it is the easiest of all fibers to dye.

Wools

The wools produced are mainly Romney and Crossbreds, which scour easily, this being of great advantage to the home craftsman as well as to the professional scourer. Short, fine Merino wools and long, staple Border Leicester and Lincoln wools are also available and are used for dyeing.

Extra care is necessary in the treatment of Merino wools to prevent matting and shrinkage. They cannot suffer much agitation in the dyebath, nor vigorous boiling, nor can they stand being plunged from cold water to hot water and vice versa. Lincoln wools have a natural lustrous appearance. This shows as a slight silky shine when the wool is dyed.

The home dyer in New Zealand has no preference for dyeing on loose wool rather than on spun yarn. Both are equally necessary and have their own advantages. On loose wool which, after dyeing, will be carded, blended and spun, level dyeing—i.e., the insertion of such material as Glauber or other coarse salts in the bath to ensure even dyeing—is not extremely important. On yarn, it is. Spinning wool in the grease (without scouring) is the quickest method for a craftsman. For this reason dyeing in skeins is to his advantage.

Natural Dyes and Mordants

Chemical dyes as well as plant dyes are universally used. Any of the modern chemical dyes can now produce the soft color shades derived from plants (and be a "fast" color) but the joy of growing your own or collecting natural dyestuffs, exploring their secrets and transferring a part of them onto a natural fiber is a pleasure akin to all plant lovers.

The majority of natural dyestuffs require a mordant for more permanent colors. The mordants used in New Zealand are the basic ones—the metallic salts, alum, chrome, iron and tin. Others employed are: copper sulfate, for green colorings; acetic acid, for "opening up" the wool fiber to receive the dye evenly; cream of tartar, in combination with other chemicals; ammonia, to macerate lichens for orchil colors; sodium bicarbonate, with alum or sheet aluminum, for some deeper tones.

New Zealand-flax

Native plants growing in their natural soils generally yield strong colors. One of the best is New Zealand-flax (*Phormium tenax*). Dyes come from the flowers, stalks, seed pods, leaves and roots. The sticky gum that exudes from the base of the plant is particularly strong. This is the same plant that was invaluable to the Maoris for clothing, baskets, nets, rope and medicines. It is now grown by gardeners in mild climates around the world for its ornamental, long, strap-like leaves.

The following experiment for dyeing with New Zealand-flax may be of interest. After the long leaves have been cut for their fiber, the butt ends near the roots are very juicy. While they are still fresh, chop off strips and soak them in water immediately. After a few days a rich cinnamon brown liquid is ready for dyeing. Place the *Phormium* chips in a butter muslin bag and return to the dye liquid. Bring to a boil slowly. At a temperature around 120° F (50° C) enter skeins of wool pre-mordanted with each of the different mordants and warmed to the same temperature. Slowly bring to a boil (this should take about 20 minutes), simmer 20 minutes, and cool in dyebath 20 minutes. The skeins show all the colors listed below. Of course, if you mordant gray wool as well as white, the color range will be increased because the dye on the gray wool will be a deeper shade still. Here is the color range of New Zealand-flax when various parts of the plant and different mordants are used:



The leaves and branches of Kawa Kawa (*Macropiper excelsum*) yield a lime-green dye with chrome as a mordant. If copper is used, a bluish-green results. The tree is also called pepper tree.

Flowers and buds

- Alum—pinkish-fawn shades and tans
- Iron and copper—shades of brown
- Aluminum and soda—pinkish-fawn
- Cream of tartar and tin—apricot shades

Leaves

- Alum plus iodized salt—pink
- Base of leaf with alum mordant—tan and apricot

Roots

- Alum—light brown
- Alum and soda—chocolate brown
- Bichromate of potash—good fawn shades
- Cream of tartar and tin—light golden brown

These result in good fast colors.

Use amount of dyestuff according to the color required—at least weight for weight with wool.

Flower stalks

- Alum—fawn shades

Other Dye Plants

Kawa Kawa (*Macropiper excelsum*), also

known as native pepper tree. Leaves and branches are used. Colors: with chrome as a mordant, lime green; with copper, good bluish-green.

Kowhai (*Sophora microphylla*). The flowers, if used with alum, bring a primrose-yellow dye. Seed pods, also with alum, produce an orange-to-tan color.

Raurekau (*Coprosma australis*). *Coprosma* is a large genus in the coffee family (Rubiaceae). The ancient dye, madder, is another member of the family. Dye can probably be obtained from most, if not all coprosmas, but *C. australis* is by far the best and can be used without a mordant. It is a small tree, 12 to 20 feet tall. The bark is a dark brown and when cut reveals a bright orange. Use it for dyeing. If a mordant is required, use a little soda—tan shades to brown-chestnut. Other mordants and their results include:

- Alum—pinkish-fawn
- Alum and soda—fawn to brown
- Copper—light to deep brown, according to dye strength
- Iron—deep brown
- Cream of tartar and tin—old gold
- Chrome—rich pinkish-fawn
- Chrome, aluminum and soda—reddish-brown
- Aluminum and soda—tomato shade
- Aluminum, soda and a few grains of tin—red

Tanekaha (*Phyllocladus trichomanoides*), also known as celery-leaved-pine. The bark of this evergreen tree contains up to 28 per cent tannin and is a substantive dye. A lovely pinkish-beige to cinnamon-brown color is obtained from the bark. A chrome mordant produces cinnamon-brown; aluminum and soda, a deeper brown.

Totara (*Podocarpus hallii*). The bark of this evergreen tree is thin and papery. The leaves are usually $\frac{3}{4}$ —1 inch long, narrow and glossy. The bark is used in dyeing. A light brown color can be obtained if the mordant is alum and soda. An iron mordant brings sage green. ♦

A WORKSHOP ON NANTUCKET

Nantucket is well known for its plants considered ideal for dyeing

Mary Ann Beinecke

THE Nantucket School of Needlery, located on Nantucket Island, approximately 25 miles from the Massachusetts coast, is a nonprofit educational institution. Sponsored by the island's Historical Trust, it trains teachers for the resident school and the Extension Course for Home Study.

Needlery combines techniques of thread and fabrics for good design and art. Textile art requires the unique creation of each element for a specific result. Our interests are necessarily widespread and include learning many craft techniques as well as all aspects of design and color. The need for designed blends and styles led our school to spinning and hence to a study of fleeces, hairs, furs and wheels. This in turn led quite naturally to vegetable dyeing.

Our Historical Trust decided long ago to include vegetable dyeing among its restoration activities. The problem was

finding knowledgeable consultants to instruct and develop a system for surveying the island and building a reference library of colors.

Our school is fortunate in having found Willi and Fred Gerber, from Florida, both Cornell-trained chemists and botanists. We sent the Gerbers a catalogue of the plants of our island, compiled by Frank McKeever and published by the Nantucket Historical Trust. They agreed to spend some time with us.

The Gerbers came to Nantucket several summers ago to prepare for an intensive three-week workshop. The first week they worked with the resident naturalist, Dave Carson, who led them to parts of the island where the plants noted in Dr. McKeever's list grew. Collecting and a few eager experiments began.

The Gerbers covered the walls with dried materials, dyed fleece and yarn samples. The building itself was ideal, well

P. W. Grace

Berries and foliage of bayberry (*Myrica pensylvanica*), a shrub prevalent in coastal areas. It tolerates sandy soil and salt-water spray. Its leaves yield a rich gray or gray-green or yellow dye.



equipped with natural light, plenty of work sinks, hot plates and outlets, dye laboratory, work tables and vented storage shelves. There was space outside for a drying line and garden.

One week was scheduled for a study of local plants, another week for classical dye sources such as madder, cochineal and cutch, and the third week for orchils from lichen. The class was divided into five working partners. Each team generally had one plant assignment a day, each of these divided between a chrome series and an alum series. We used as a base the worsted yarn developed for needlery by our school as well as felted wool strips for hooking.

The next summer the Gerbers returned, this time for a week's spinning and two week's vegetable dyeing. The assignment following the previous workshop had been to develop an efficient universal cataloguing system to facilitate not only our filing but cross-referencing with others in the field.

The Gerbers had in the meantime added

a post-mordant ammonia step so that a series now included several mordant combinations, for example: alum; alum-ammonia; tin and tartar; tin and tartar-ammonia; copper; copper-ammonia; copperas; copperas-ammonia. Besides a doubling of samples in each series, we added fleece to the yarn and felted wool bases. Two recipes were assigned to each team, making a total of 160 samples a day. The instructors did the collecting. In addition to the sheer weight of numbers, filing was complicated by the desire to catalog both an unspun and a spun sample. We also discovered that a very real part of the joy of vegetable dyeing lies in the collecting.

We have no doubt that the pooling of resources, files, energy and time, as well as the sharing of knowledge of experiments and exchange of ideas, will produce a revival of vegetable dyeing as a part of contemporary living. To that end, the Nantucket School of Needlery continues to implement the dyeing section of its rare book library and invites any interested scholar to "come study." ♦

Philip B. Mullan



Naturally dyed yarn can be used in many crafts. A pot holder has been crocheted with yarns dyed from blossoms of the tree *Sophora japonica*. The needlepoint pin holder (right) uses varying shades of maroon-pinks and purples derived from madder and brazilwood. Made by B. K. Mulligan, Botanic Garden staff.

The skilled dyer combines a sensitivity for color with many of the skills of the chemist

THE CHEMISTRY OF DYEING

Beth Parrott

DYEING is a chemical process and dyes and fibers are chemicals. Dyers who have followed a recipe to arrive at a pleasing result often wish to understand something of the chemical skills and materials involved in the process.

Long before W. H. Perkin's discovery of synthetic mauve in 1856, dyers were attempting to understand and record the properties of the dyestuffs and auxiliary chemicals they used. In 1806, Elijah Be-miss wrote in *Dyer's Companion*:

"The five Material Colours are these, Blue, Yellow, Red, Brown, and Black; the three powers are these, the Alkali, the Acid, and Corrosive; these are the depending powers of all colours; which I shall endeavor to show in each colour in course."

For Be-miss and his contemporaries, dyes and mordants were drugs. The druggist was interchangeably known as the chemist. Today, many of us still turn to the druggist or chemical company as a source for the materials we use. In turning to the chemist for information we can clearly benefit as well.

Fibers

In most natural dyeing, the chemistry of the fiber is as important as that of the dyestuffs. Two categories of fibers are used by most natural dyers. (A third type, synthetic, is beyond the scope of this Handbook.) These fibers are usually classified by their origin as animal or vegetable.

Fibers of animal origin, wool and silk, are made up primarily of protein. These fibers have many points, called active centers or sites, along them which are chemically active. They have the ability to act as both acids and alkalis (bases) and have considerable natural affinity for dyestuffs.

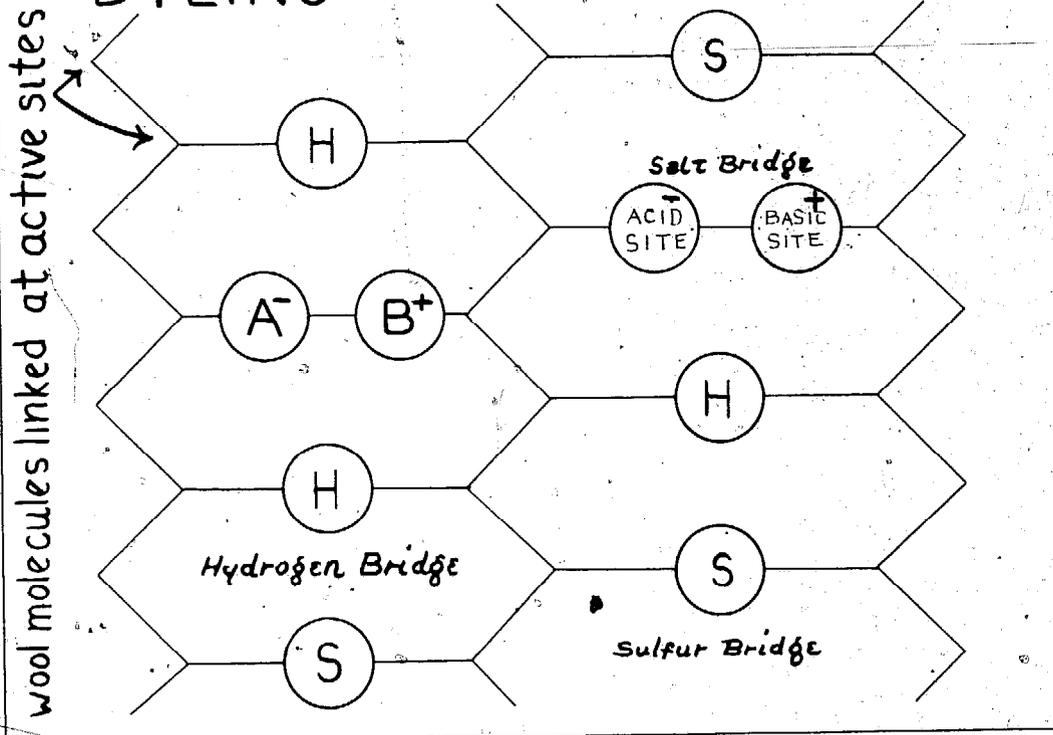
The wool fiber, which we will use as an example of this group, consists of many long protein molecules, lying side by side and joined by a variety of links or bridges. These bridges are also the major sites of dye attachment in the cases of chemically bonded dyes, as well as the sites of attack by chemicals which destroy the fibers. In order for their natural affinity for dyes to be utilized, the fibers must first be wetted. Water acts to weaken or interrupt the links between adjacent molecules so the dyestuffs may be attracted to these chemically active sites.

At positions of acid or alkaline character, the neighboring protein molecules are oppositely charged (the acid site is negative, the alkaline site positive). Since opposite charges attract one another, a link between the molecules is formed called a *salt bridge*. Acid dyes which are negatively charged and basic (i.e. alkaline) dyes which are positively charged can substitute at these sites for the neighboring protein, forming salt bridges with the fiber.

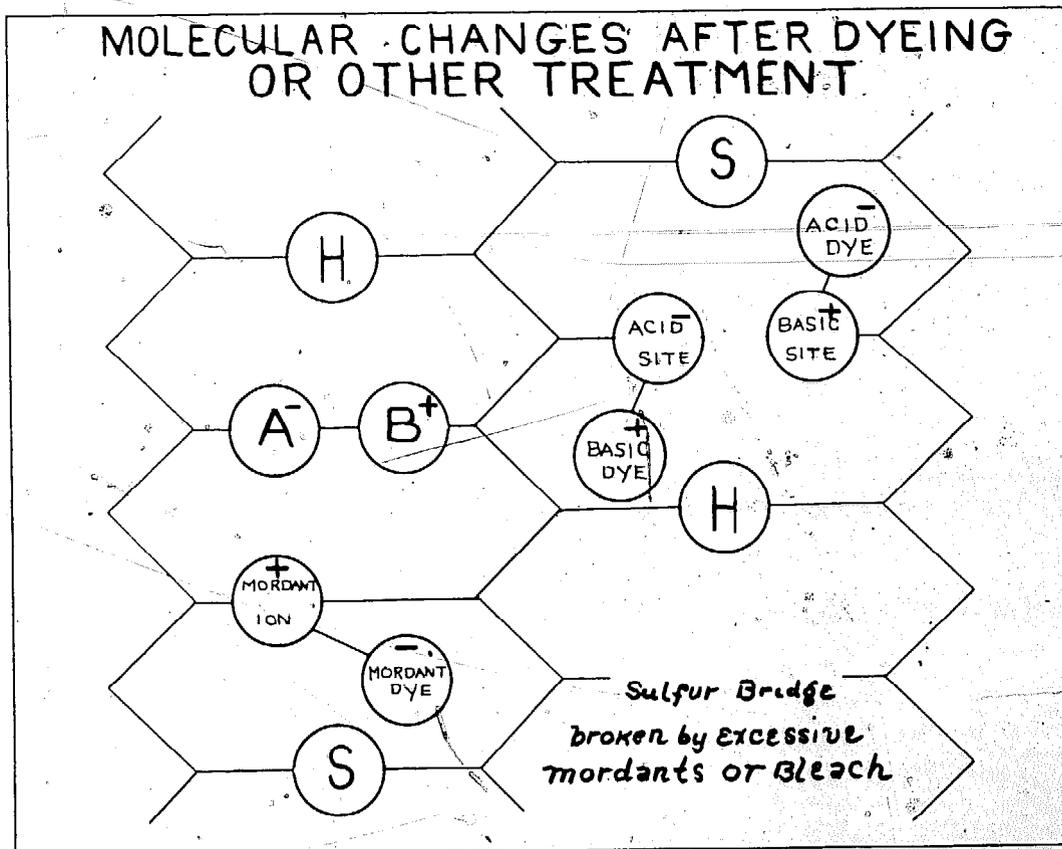
A second, weaker linkage between the neighboring protein molecules in the wool fiber occurs in parts of the molecule which are not able to act as acids or alkalis, but nevertheless are richer or poorer in electrons (negative). Areas occur which are slightly more negative or slightly more positive than the molecule as a whole. Links between the slightly positive areas of one molecule and the slightly negative areas of its neighbor are called *hydrogen bridges* (since hydrogen is almost always the slightly positive site). These hydrogen bridges are the site of attachment of the mordant-metals.

A third link between parts of the wool fiber occurs at positions where the chemical sulfur is part of the protein molecules. A strong, nearly permanent link de-

WOOL MOLECULES BEFORE DYEING



MOLECULAR CHANGES AFTER DYEING OR OTHER TREATMENT



velops between sulfur atoms on adjacent protein molecules, and these *sulfur bridges* form the backbone of the permanent structure of the wool fiber. These links are not involved in dyeing, but are destroyed by treatment with strong acids, alkalis and oxidizing agents such as bleaches. When these links are destroyed, the wool is essentially worthless, because the protein molecules are no longer linked together.

Vegetable fibers are predominantly cellulose, a complex carbohydrate in which nearly all of the chemically active or electrically attractive sites are already tightly bound up in the formation of the molecule itself. In some hydrogen bridge sites, the unlinked oxygen atoms are available and are probably the location of bonding for the direct cotton dyes. The mordanting of cotton and linen by the alum-tannic acid-alum method is really the breaking apart of the fiber in ways which allow additional chemical and electrical sites to be available to the mordant metals and/or the dyestuffs for interaction.

It may also include the permanent incorporation of parts of the tannic acid into the carbohydrate molecules, which make up the cellulose fibers, and then be followed by the bonding of the dyestuffs to salt bridges or hydrogen bridges in these bound tannic acid fragments as well as to those in the cellulose fiber itself.

Dyes

Natural dyes are water-soluble materials having the capacity to impart color to fiber. They play a variety of roles in the plant and animal sources from which they come, sometimes in their colored form, and sometimes in uncolored ones. When the dye is already present in its colored soluble form within the plant, as in the case of dahlia or marigold, processing the dye may be rapid and relatively simple. In other cases fermentation may be necessary to convert it to a soluble and/or colored form, requiring more complex and time-consuming methods. In the case of indigo, fermentation yields a soluble but colorless form. This solubility is

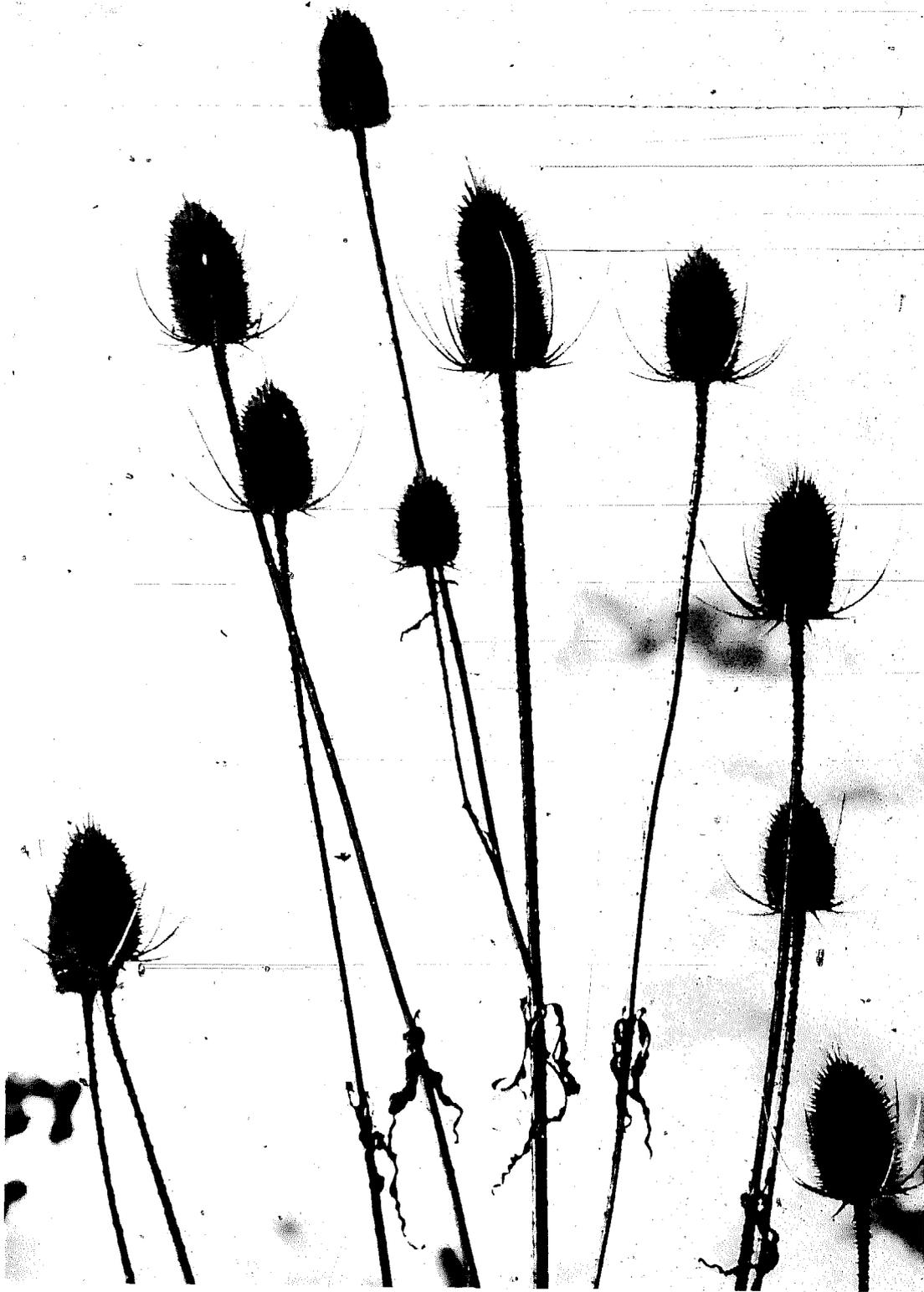
necessary initially to remove the dyestuff from the plant material and, later, for the dyestuff to penetrate the fiber. In the case of logwood, a colorless, relatively insoluble form occurs in the fresh wood. During fermentation, a colored and more soluble form is produced which is readily removed from the wood and is ready for dyeing.

When dyes dissolve in water they may remain intact molecules, in which case they are neutral (have no electrical charge), or they may come apart chemically (dissociate) into smaller charged units called ions. The charges on these ions may be positive or negative, though the negative type is more common (See Acid Dyes below.) The form in which a dye occurs in water solution is of great importance, since it affects the way it works. For this reason dyes are classified as chemical or mechanical on the basis of how they work. In practice there will, however, be some overlapping.

(A) *Chemically Bonded Dyes*, in which a chemical relationship or reaction occurs between the dye and the fiber.

1. *Simple Dyes* (Substantive) which have a direct affinity for the fiber and are usually themselves colored. These are often fugitive but their fastness may be improved by aftertreatment with copper or iron. All natural dyes which chemically bond to wool without a mordant are in this group, but dyes such as the orchil lichens which are not affected by mordants are the best example. They can apparently act as either acid or basic dyes, with the color changing from pink in acid to blue in alkali. (See diagram.)

a. *Acid Dyes*, which dye wool and silk directly in an acid or neutral bath. These dyes tend to be very easy to apply, and clear in shade, but have poor fastness to washing and limited fastness to light. The dye fragment in this case is a negatively charged ion. The berry dyes are all in this group, with the natural acids acting to promote the dyeing process. Additional acid, as vinegar, often aids the process, especially in low-acid berries, such as those of pokeberry.



P. W. Grace

Teasel (*Dipsacus sylvestris*) is a biennial weed whose seed heads are often sought for dried arrangements. Both flower heads and leaves will yield a yellow dye (with alum as a mordant).

Degree of dye uptake, evenness of dyeing, and fastness may be improved by the use of leveling agents such as common salt or Glauber's salts. Leveling agents derive their name from their capacity to aid even dyeing as well as evening the colors of fibers dyed in different lots. (See diagram.)

b. *Basic (Alkaline) Dyes*, which dye wool and silk from an alkaline bath and dye cotton after treatment with tannic acid. Color fastness is fair to poor, but ease of dyeing is an advantage. Ions of these dyes are positive. There are some dyes which dye wool without mordants or other auxiliaries; the so-called contact dyes are in this class. Hot-water lichen dyes are an example of this group. Soap residue from scouring, fermentation products, especially from urine or ammonia ferments, and 'mordants' which may not be acting as true mordants (all mordants produce an alkaline condition except chrome) may obscure natural basic dyes.

c. *Direct Dyes* which have a direct affinity for cotton. These dyes show poor fastness to wet treatment, good-light fastness, and ease of application. The best example of this group is turmeric yellow.

2. *Mordant Dyes* in which positively charged metal ions form a bridge between the fiber and the dye-stuff molecules. The metal ions usually used are aluminum, chromium, copper, iron or tin. While the fiber may in some cases be subjected to the mordant at the same time as the dye, or even afterwards, the usual procedure is to treat the fiber with the mordant in the form of a metal salt, forming a fiber-ion unit before dyeing. This process is followed by the introduction of dye which forms an insoluble complex salt (sometimes called a lake) with the metal within the fiber, yielding a fiber-ion-dye unit. (See diagram.)

Many dyes can act to some degree as acid or basic dyes but will dye with greater intensity and fastness if mordants are used. Other dyes will not respond to the fiber except in the presence of the



Marjorie J. Dietz

The pokeberry's dark red berries yield a dye. The berries are low in acid; the dyeing process is improved by the addition of vinegar.

metals. Dyes in the latter group are known for good to excellent light fastness, relatively good fastness to water treatment, and clear resultant colors. An additional advantage, that the colors obtained from a particular dyestuff may be varied rather widely according to the mordant used, more than makes up for the increased complexity of the dye process.

Among the oldest dyes to fall into this category is madder, which has traditionally been used with an alum mordant. One of the "mordant dyes" with the greatest range of reported colors is logwood, which, depending on the length of the fermentation to remove the dyestuff from the wood, the choice of mordants and the time of application of the mordants, can apparently produce reds, purples, blues, grays and blacks. Almost endless variation was obtained by combining with other dyestuffs. While I have not found reference in the dye literature to obtaining yellow from logwood, the chemical literature indicates that hematein, the coloring material from logwood, also takes on a yellow form.

While the effect of a particular mordant will vary greatly with the color and dyestuff with which it is used, the following generalizations seem to be true in most cases.

Aluminum—Produces brightest shades; least fast to light (not as bright as tin).

Iron—Saddens; produces the very duldest shades; good fastness to washing; relatively good fastness to light.

Copper—Produces greening effect; improves light fastness.

Chromium—Best fastness to washing; relatively good brightness; strengthens colors; good light fastness.

Tin—Brightens; good water and light fastness. (Should be used with extreme care because of effect on wool.)

(B) *Mechanically Bonded Dyes*, in which NO chemical relationship occurs between the dye and the fiber. All natural dyes in this group are *Precipitate Dyes*, including the *Vat Dyes*, which are pigments developed on or within the fiber. Insoluble pigments are treated to make them soluble, usually with alkali and/or a bacteriological ferment or chemical reducing agent. They are then adsorbed by the fibers and converted back to the insoluble form. While these dyes require the most complex and time-consuming procedures, they are the most durable dyestuffs known. Fastness to wet treatment and light, deep intense colors, and interchangeable use (in most cases, on both animal and vegetable fibers are among their advantages. They also include some of the oldest dyestuffs known. Prussian-blue and chrome-yellow are inorganic dyestuffs in this group. The plant world contributes woad and indigo, and many of the shellfish dyes, including the Tyrian-purple of the Ancients, fall into this group. In fact, the chemical structure of the coloring material in indigo and tyrian-purple are nearly identical.

Repeated layers of dye deposits are necessary to produce deep colors. Because these are mechanically deposited dyes, and do not involve a chemical reaction with the fiber, the vat process is far less dependent on the nature of the fiber.

However, since no chemical interaction exists between dye and fiber, vat dyes often rub off.

Factors Affecting Formation of the Dye-fiber Unit

Temperature. Increased temperature, particularly in the presence of water, tends to expand the fiber structure. This is important in providing greater surface area for the dyestuff to penetrate and on which to bind. Prolonged exposure to high temperatures, especially of animal fibers to temperatures above 180°F., tends to break down the strong structural bonds within the fiber, leading to pronounced deterioration of the material. Temperature may also have an effect on the dyestuff. An excellent example of this is the rapid deterioration of indigo at temperatures above 140°F.

pH. This is a chemical measure of acidity and alkalinity, neutral being 7 on a scale from 1-14. Numbers below 7 indicate acid conditions, with 1 being the strongest acid. Numbers above 7 indicate alkali, with 14 being the strongest base. Test papers which show a simple color indication of the pH of a solution are available from many druggists and most chemical supply houses. Also, a simple liquid pH test kit, available from pet stores for testing the water in aquariums, may be used.

The importance of pH cannot be stressed enough. The role of electrical charge in dye-fiber unit formation should be clear to the dyer. The pH is important in relation to these processes, because in acid solution there is an excess of positive and in alkaline solutions, an excess of negative charges. In the bonding of acid dyes to the fiber, acid is necessary to encourage bonding to occur. Similarly, alkaline conditions encourage the bonding of basic dyes. Later washing or rinsing of the dyed fiber in solutions of the wrong pH, as, for example, washing acid-dyed fibers in soap would cause the dye to "bleed" rapidly. For this reason a vinegar rinse is apt to be used for washing an acid-dyed fiber while a soap rinse may be indicative of an alkaline dye-stuff.

With mordants, however, strive to use neutral water, since the mordants themselves contribute alkali (except for chrome, which in the form of potassium or sodium dichromate is acid). Since the bonding of the mordant is at the slightly charged hydrogen bridges they may be sensitive to minor changes in pH.

As previously mentioned, the fibers themselves may be destroyed by strong acids or alkalis. The quality of the fiber will also be adversely affected by long

exposures to milder acids and bases. Dyeing times in these solutions should be kept to the minimum necessary for adequate color.

Oxidation and Reduction. For our purposes these terms refer respectively to increasing or reducing the quantities of oxygen in the chemical structure of a substance. Oxidation and reduction are the key to the use of vat dyes. In the vat dyes, the oxidized form of the dyestuff is not soluble in water and therefore cannot

A Color Range from Cochineal

FOR *crimson red and scarlet colors* use four $\frac{1}{2}$ oz. skeins 2-ply medium weight wool and $\frac{1}{2}$ oz. powdered carmine cochineal. Preparation of bath: Tie cochineal in closely woven cloth bag and soak overnight in 2 qts. water. Next day boil vigorously for 15 minutes. Squeeze out as much dye as possible from the cochineal and remove the bag from the bath. Add enough water to bring the bath to 2 qts.

Dyeing the yarn: Place 2 unmordanted skeins and 2 alum-mordanted skeins in dyebath and simmer for $1\frac{1}{2}$ hours. (The letters that follow in parentheses refer to the different colors obtained. See below.) Remove 1 unmordanted skein (a) and 1 alum-mordanted skein (b) from bath, rinse and dry. Divide the bath into 2 pots. Leave the second alum-mordanted skein in $\frac{1}{2}$ of the bath to cool for several hours, then rinse and dry (c). To the other half of the bath add a pinch of tin and $\frac{1}{4}$ tsp. cream of tartar. Simmer in this bath the second unmordanted skein for 15 to 20 minutes more. Then add $\frac{1}{4}$ tsp. citric acid and simmer the skein for an additional 10-15 minutes. Rinse and dry (d).

Colors (according to the Royal Horticultural Society color chart):

- a) Unmordanted—ruby red
- b) Alum—chrysanthemum crimson
- c) Alum cooled in bath—cardinal red
- d) Unmordanted + tin + citric acid—currant red

For *purple, lavender and rose colors*, use four $\frac{1}{2}$ oz. skeins 2 ply medium weight wool and $\frac{1}{2}$ oz. powdered carmine cochineal. Preparation of bath: Follow the same procedure described above. *Dyeing the yarn:* Add 2 tsp. white vinegar to bath and simmer for 10 minutes. Place 2 unmordanted and 2 chrome-mordanted skeins of yarn in bath and simmer $1\frac{1}{2}$ hours. Remove 1 unmordanted skein (e) and 1 chrome-mordanted skein (f); rinse and dry. Divide the bath into 2 pots. Allow the second chrome-mordanted skein to cool in $\frac{1}{2}$ of the dyebath; rinse and dry (g). To the other half of the bath add a pinch of tin and $\frac{1}{4}$ tsp. cream of tartar. Simmer the remaining unmordanted skein for 15 minutes more; rinse and dry (h). Colors:

- e) Unmordanted—fuchsia purple
- f) Chrome—orchid purple
- g) Chrome cooled in bath—erythrite red
- h) Unmordanted + tin—Indian-lake red

—Palmy Weigle

reach the fiber. A biological or chemical reducing agent (e.g. fermentation or sodium hydrosulfite) is used to turn the dye into the colorless soluble form. After the dye has reached the fiber, oxygen in the air oxidizes the dyestuff to the colored but insoluble form which remains on the fiber.

Oxidation affects the sulfur bridges and eventually destroys them. While oxygen in the air is not strong enough to affect this change, the bleaches which are used on wool can destroy these links rapidly. Hydrogen peroxide and sodium hypochlorite, used as stripping agents to remove color from previously dyed fibers, as well as other stripping agents, are essentially bleaches and oxidizing agents; for this reason the quality of wool stripped of its dye for redyeing will always be poor.

Dyestuffs which are not strongly linked to the fibers may be susceptible to oxidation by the air. This often may result in changes of the colors, or even total loss of color. The changes that occur in berry colors with aging may be an example of this. Since light speeds up the process of

oxidation in air, it may be helpful in the air oxidation of indigo, but may also be responsible for the sunfading of some colors, particularly those applied without the use of mordants.

Other Factors

Cleanliness of the fibers before dyeing is important. Foreign matter, particularly oils, naturally present in wool and often introduced in the spinning of other fibers, may interfere with the penetration of the dye. Cleansing agents used to scour the fibers should be rinsed out thoroughly, since they are often alkaline and may adversely affect the formation of the dye-fiber unit. Water softeners should be used with caution since they may introduce acid or alkali, or result in mineral precipitates which can cause uneven dyeing.

All chemical additives, including mordants, should be used in the minimum amounts necessary to accomplish the desired uptake of the dye. Excess mordants can attack the structural bonds of the fibers, causing deterioration or they may remain in the fiber, resulting in later unevenness of the dye. ♦

P. W. Grace



Philip B. Mullan



Zinnias, in many forms and colors, are among the most commonly cultivated annuals in most gardens. At left are the large-flowered double zinnias, at right, the variety known as 'Sombrero'. All zinnias yield warm gold to harvest dye colors.



Hoke Denetsois, courtesy Bureau of Indian Affairs

WORDS TO A YOUNG WEAVER

We are the Dineh, my child
With the Earth we live
With the Sky we live
With the plants we live
We know their ways.*

*Heed well the plants, my child.
Learn the ways of each, my child.
Some you must ask for gently,
Pick their tips
Heat them softly
And they give.*

*Some you must demand of strongly
Dig through the rock
Pound hard the roots
You will tire
And they will give.
Give to each as it requires
It will give to you, my child,
It will give to you.*

*We are the Dineh,
With the Earth we live
With the Sky we live
With the Plants we live
We know their ways.
Nature comes as it comes*

* Navajo word for themselves meaning "the people."

*Gives as it gives.
We do not plan Nature.
We do not control Nature.
It is so in dyeing the wool.*

*Receive your colors as they come.
Learn the ways of each.
Some plants dye strong enough alone.
Some take strength from other things.
The Ashes of the Juniper
The Minerals of the Soil
Give to the weak, strength, my child
And the colors that come are good.*

*The Red of the cliffs at sunset, will come.
The Yellow of the shimmering sand, will
come.
The Green of the plant life around, will
come.
The Black of the thunderclouds heavy will
come.
All good colors will come, my child.
All good colors will come.*

*And do not try to match a color of the
past.
This is a new day.
This is a new plant.
The colors that come forth are many,
None will be the same
And each that comes is good
And each that comes is good.*

—Noël Bennett

SOUTHWEST NAVAJO DYES

Noël Bennett

NAVAJO dyeing reflects togetherness with nature. No chemical mordants are used *per se*, only those that occur naturally. These are added right to the dye-bath, resulting in a process with appealing directness and simplicity.

Mordanting: Specific Instructions

1. **RAW ALUM** (tsé dík óózh). An alkaline crystal-like substance found in washes or other areas of recent water evaporation. Add $\frac{1}{4}$ cup directly to dye-bath, boil 10 minutes and strain.

Substitution with similar results:

Aluminum potassium alum. Use 1 tsp. in dye-bath.

2. **CEDAR ASHES** (ga dí lit). Ashes prepared from the juniper (*Juniperus monosperma*) which is called "cedar" by the Navajo.

Preparation: Collect juniper branch tips about 1 ft. long. Build outdoor fire on windless day. Set fire to each branch and lay it on a grill with a container beneath to catch ashes. Dyeing $\frac{1}{4}$ lb. yarn usually requires $\frac{1}{4}$ cup ashes. Ashes may be stored for future use.

Uses: Ash water: Juniper ashes may be added to twice the amount of boiling water, then stirred and strained. Mixture is then added to dye-bath when the recipe calls for a mordant. No subsequent straining is necessary. *Ashes:* Juniper ashes may be added directly to the boiling dye-bath at the time mordant is desired. The dye-bath is stirred, boiled 10 minutes, and then strained. $\frac{1}{4}$ cup ashes = $\frac{1}{2}$ cup ash water.

Substitution with similar results:

Ashes from burned logs or other hardwood.

3. **SALT:** Rock and regular salt are sometimes added directly to the dye-bath, with no straining required.
4. **SODA AND BAKING POWDER:** These are much like raw alum and are

also added directly to the dye-bath. No straining is required. As with alum and ashes, water should not be near top as foaming frequently results in overflow.

5. **IRON AND ALUMINUM PANS:** These create duller shades. Rusty iron objects are also used.
6. **COAL.** If unavailable, use charcoal briquets.

Dyeing

Rabbitbrush, sagebrush, wild-carrot and mountain-mahogany recipes are given below. A variety of colors may be obtained and several dye methods and mordants tried.

RABBITBRUSH (*Chrysothamnus graveolens*) (G'iiso—"that which is very yellow")

Color Range: Yellows, mustards.

General Description: Rabbitbrush is very easy to collect and one of the best plants to experiment with in terms of mordants and pans. It can be used year round, the yellow color being brightest during late summer bloom. This dye is extremely color-fast. The various species of this clumpy shrub grow from 1 to 5 feet tall. Rabbitbrush grows abundantly at all elevations, and bright yellow flowers cover the plant in late summer. It is especially common along highways where runoff increases moisture. Leaves are long, thin and of uniform width.

Part Used: Freshly snipped flowers for bright yellow; or other newly cut plant parts if yellow with greenish tinge is desired.

General Dyeing Procedure: Fill 3-gallon enamel pot with packed rabbitbrush clippings. Add water to $\frac{3}{4}$ mark. Boil one hour and remove plant material. Add one of the mordants below depending on color desired. Add $\frac{1}{4}$ lb. wet, hot yarn. Simmer $\frac{1}{2}$ hour for lighter

tints, 1-3 hours for deeper shades. Rinse in water.

Rabbitbrush Mordants

Clear Yellow Color. No mordant required.

Bright Yellow. Add 1 tbs. commercial alum, boil 10 minutes and stir.

Yellow with Orange Tinge. One tbs. soda, stir, boil 10 minutes.

Yellow with Greenish Tinge. One tbs. baking powder, stir, boil 10 minutes; or ¼ cup raw alum, stir; boil 10 minutes. Strain.

Mustards and Ochres. An aluminum pan will dull colors into an ochre range.

SAGEBRUSH— (*Artemisia tridentata*) (Ts'ah)

Color Range: Yellows, greens.

General Description: Sagebrush is a very common shrub growing in the Southwest at elevations between 4,500-8,000 ft. From a distance the foliage has a blue-gray tinge. The leaves, small, thin and with three dents at the tip, have a sage odor when rubbed between the fingers.

Gathering Technique: Snip off twigs with leaves and use them fresh. Sagebrush may be prepared according to rabbitbrush recipe to produce shades of yellow.

For Yellow Green:

1) Fill 3-gallon aluminum pot with sagebrush clippings. (Don't use the flowers.) Add water to ¾ mark. Boil gently 10 minutes. Remove plant material. Add equivalent amount of fresh sagebrush clippings. Simmer 10 minutes. Remove plant material.

Result: Greenish-yellow liquid that is clear.

2) Add following mordants to boiling dyebath to turn water a deep, opaque green: ¼ cup cedar ashes; 3 rusty items (iron); 3 charcoal briquets, or coal.

3) Simmer 10 minutes, stirring constantly. Remove all objects and strain well. Set aside for 2 days.

4) Add ¼ lb. wet, hot yarn. Simmer 10 minutes. Remove yarn. Add ⅛ cup salt. Stir well.

5) Reenter yarn. Simmer 10 minutes. Leave in dyepot overnight. Dry. (This gives a distinct yellow-green and may be used at this state if colorfastness to water is not important.)

6) Rinse in cold, still (not running) water for a slightly more yellowed green, or in two-week old urine for a gray-green.

WILD-CARROT (*Canaigre, sorrel*)*

(*Rumex hymenosepalus*) (Chaat'inii)

Color Range: Burnt red-orange, orange, ochre, dark brown

General Description: Wild-carrots are "ghost" plants. They appear in spring with fleshy, broad, dark green leaves, above which are a single-stemmed flower cluster. Almost overnight they are nowhere to be seen, a shriveled black shadow marking their spot—the foliage having withered and died. It is at this time they are gathered.

Wild-carrots are high in tannic acid and thus require no mordant for permanency and color fastness. The resulting dyes are unaffected by direct sun over the years. In addition, successive dyebaths yield continuing color.

Although not required for permanency, addition of soda to the dyebath will brighten and increase the orange color. These plants are particular in their growing locations, occurring most abundantly in sandy soil. Their root systems are extensive. It is best to inquire of local residents when seeking these plants, as sites on reservations are few and far between. It is recommended that you follow the normal conservation practices when gathering.

Part Used: Roots.

Collecting: Dig deeply with shovel around dried foliage to depths between 1-2 ft. Gather both new roots (bright

* Not to be confused with Queen Anne's-lace (*Daucus carota*).

orange when broken) and old "rotten" ones (last year's crop). Each type results in a different color.

Storage Procedure: Roots can be used dried or fresh. *To dry:* Cut into pieces and lay them out in sun for several days. Turn them occasionally. When ready for use, dried pieces must first be soaked overnight.

Dyeing Procedures:

- 1) Cut roots into pieces. Add water in a 1 (roots) to 4 (water) ratio. Soak overnight if dried. Boil 1-2 hours and remove plant material. Strain.
- 2) Add mordant for colors described below. Add wet, hot yarn. Simmer 1 hour.
- 3) Rinse immediately or leave in pot overnight depending on depth of color desired.

Gold-orange

Aluminum or enamel pan. No mordant required. Young roots with orange interiors.

Burnt red-orange

Young roots with orange interiors. Use a metal pan. 1 tbs. baking soda. 1 tbs. salt.

Ochre-brown

Aluminum or iron pot. Old (rotten) carrots. No mordant.

Dark brown

Iron or aluminum pan. Old (rotten) carrots. 1 tbs. soda. 1 tbs. salt.

MOUNTAIN-MAHOGANY (*Cercocarpus montanus*) (Tse'esdaazii—"that which is heavy as stone")

Color Range: Burnt-orange, red-brown, purplish-brownish-rose

General Description: Nature has a way of protecting its treasures. Mountain-mahogany produces one of the most color-fast dyes in the lovely reddish hues that are hard to obtain naturally and locally.

This shrub tree grows in higher elevations of the Southwest (about 7,000 ft.). Found in very rocky soil, mountain-mahogany discourages all but very determined gatherers.

Serrated leaves are located in clusters directly upon the twig. The leaf is basically oval in shape (less than twice as long as it is wide) with prominent veins especially on the lighter underside. At some times of the year a long plume is present. Roots when scraped are a beautiful dark red.

Parts Used: Bark of the root.

Gathering Technique: Come well prepared for gathering—this plant seems to thrive in pitting its strength against human persistence. Dig for the roots with pick and shovel. Collect as much of the roots as you have energy for.

Additional Preparation: Haul roots home and begin pounding to release bark. Pound along root with heavy, flat rock or hammer on hard, smooth surface (cement). A large pile of roots yields a seemingly insignificant pile of bark. The bark must be soaked overnight in water.

General Dyeing Instructions:

- 1) Put 1/2 lb. root bark in 3-gallon enamel pot. Add water to 3/4 mark. Boil 2 hours. Remove plant material. Replace evaporated water. Bring to boil again.
- 2) Add mordant for colors below. Add wet, hot yarn . . . 1/4 lb. Simmer 1 hour. Leave in dyebath overnight. Remove yarn and rinse.

Pale reddish-brown (color of sandstone)
No mordant required.

Deep burnt-orange (like sandstone cliffs in the sunset)

Mordant: Add 1/4 cup ashes or 1/2 cup ashwater. Strain if ashes are added directly. Add yarn. Simmer 1 hour. Remove yarn. Add 1/4 cup salt. Stir until dissolved. Reenter yarn and simmer 1/2 hour. Leave the yarn in the bath overnight.

Purplish-brownish-reddish color

Use aluminum pot. *Mordant:* 1 tbs. soda. 1/4 cup ashes or 1/2 cup ashwater. Stir. Boil 10 minutes. Strain if ashes are added directly. Reenter yarn. Simmer 20 minutes. Leave in dyebath overnight.

BOOKS FOR FURTHER READING

Elizabeth Alexander

THIS is not meant to be a complete list but does include some of the available books that deal generally with the subject of dyeing. There are many others that are concerned primarily with local plants and methods.

Natural Dyes in the U.S. by Rita J. Adrosko. Smithsonian Institution Press, Washington, D.C. 1968; also available in soft cover (Dover Books).

An extensive history of dyeing from 2000 B.C. comprises Part I. Part II has information on dye plant equipment, preparation of the dyebath, and scouring of wool and cotton. Discussion of mordanting, fastness and top dyeing. Recipes for 37 plants. Botanical names included. The book has several appendices: common names of chemicals; dyes occasionally mentioned in *Dyers Manuals* printed in America; excerpts from old *Dyers Manuals*.

Lichens for Vegetable Dyeing by Eileen Bolton. Studio Books, London, 1960. Reprinted by Robin & Russ Handweavers, McMinnville, Oregon, 1972.

In part, a history of lichens as dye plants. Preparation of dyebaths for lichens, including those using water extraction and those requiring ammonia extraction. Uses of dyes on wool, silk, feathers, leather and marble. Botanical names included. Color plates showing lichens in both the wet and dry state.

Navajo Native Dyes by Nonabah Bryan. U.S. Dept. of Interior, Haskell Institute, Kansas, 1940.

Preparation of wool and native preparation of mordants. Discussion of 33 local plants. Botanical, common and Indian names, as well as photographs of each plant.

Hopi Dyes by Mary-Russell Colton. Mu-

seum of Northern Arizona, Northland Press, Flagstaff, Arizona, 1965.

Pre-historic dyes in relation to the Indian of the American Southwest. Hopi methods of preparing wool, cotton and basket material, also mordants. The Hopi used 11 plants as dyestuffs. Botanical, common and Indian names.

Vegetable Dyeing by Alma Lesch. Watson-Guptill Publications, New York, 1970.

Extensive list of equipment used in home dyeing. Preparation of animal and vegetable fibers, including silk, wool, cotton, jute, sisal, linen, raffia and grasses. Dyebath preparations. Explanation of mordanting, mordants, leveling and fastness. Of the 151 recipes, 40 are concerned with widely distributed plants. Traditional dyestuffs also discussed.

Dyes from Plants of Australia and New Zealand by Joyce Lloyd. A. H. & A. W. Reed, Ltd., Wellington, N.Z. 1971.

Eight ancient dyes are mentioned in a chapter on the history of dyeing. Detailed explanation of equipment needed and preparation of wool and mordants. Separate chapters on various dye plant groups. Well illustrated, with common and most botanical names. Included are 119 dye plants. Although this book is devoted to a specific region, many of the plants are available in other lands.

The Use of Vegetable Dyes by Violetta Thurstan, Dryad Press, Leicester, England, 1967.

Detailed discussions on collecting plants, preparing dyebaths, mordanting and scouring of wool. The importance of particular dyes in England. Most botanical as well as common names. The book includes 37 locally available plants, 7 lichens used throughout Great Britain and 13 traditional dyes. ♦

DYE PLANT SUPPLIES

Darrel Bailey, 15 Dutton Street, Bankstown, New South Wales 2220, Australia. (Dye material and fleece)

Bartlett Mills, Harmony, Maine 04942. (Woolen yarn)

Briggs & Little Woolen Mill Ltd., Harvey Station, New Brunswick, Canada. (Natural woolen yarn)

Wm. Condon & Sons, Ltd., 65 Queen Street, Charlottetown, P.O. Box 129, Prince Edward Island, Canada. (Natural woolen yarn)

Dharma Trading Co., P.O. Box 1288, Berkeley, California 94701. (Dyes and yarns)

Earth Guild, Dept. S, Hot Springs, North Carolina 28743. (Mordants, yarn and fleece)

Henry's Attie, 5 Mercury Ave., Monroe, New York 10950. (Yarns, wholesale)

The Mannings, R.D. 2, East Berlin,

Pennsylvania 17316. (Yarns, mordants and dyes)

Northwest Handcraft House, Ltd., 110 West Esplanade, North Vancouver, British Columbia, Canada. (Dyes, mordants, yarns)

Straw Into Gold, 5550 College Avenue, Oakland, California 94618. (Yarns, dyes and seeds of unusual dye plants)

World Wide Herbs Ltd., 11 St. Catherine Street East, Montreal, Canada 129. (Dyes and mordants)

The above list was compiled from references of various dyers. For more complete information, send \$3.00 for Suppliers Directory published by The Handweavers Guild of America, 65 LaSalle Rd., Box 7-374, West Hartford, Connecticut 06107.

—Palmy Weigle

P. W. Grace



The wood horsetail (*Equisetum sylvaticum*) in early spring. The stalks will yield a warm gray with alum mordant.



Marsh-marigold (*Caltha palustris*) has yellow flowers in early spring that yield a yellow dye with alum mordant.

INDEX OF NATURAL DYE SOURCES

(Numbers in boldface indicate illustrations)

- Andropogon*, 20
Aretostaphylos uva-ursi, 39
Artemisia tridentata, 61
Asclepias suriaca, 18
tuberosa, 18
Balduina, 20
 Bayberry, 14, 49
 Bearberry, 39
 Bedstraw, 20
 Beggar-ticks, 19
Betula pendula (alba), 41
Bidens, 20
tripartita, 19
Bigelovia nudata, 19
virgata, 19
 Birch, European, 41
 Blackeyed-Susan, 14
 Brazilwood, 50
 Butterfly-weed, 18
 Butternut, 20, 34
 Cactus, see *Opuntia*
Caltha palustris, 64
 Canaigre, 61
 Carrot, 2, 6
Cassia aspera, 19
fasciculata, 19
 Cedar, 60
Cercocarpus montanus, 62
Cetraria islandica, 39, 39
Chenopodium album, 22
 Cherry, Black, 19
 Chestnut, American, 20
Chrysopsis, 19
Chrysothamnus graveolens, 60
Cladonia, 17, 29, 30
pyxidata, 37
strigosa, 17
 Cochineal, 22, 36, 38, 50, 57
 Coffee, 13
Convallaria, 14
Coprosma australis, 48
Coreopsis, 13, 33
Coreopsis, 18, 20, 33
major, 19
tinctoria, 33, 33
 Cosmos, 13
 Cudbear, 37
 Cutch, 50
Dactylopius coccus, 22
Dahlia, 9, 13, 18
Daucus carota, 18
Dipsacus sylvestris, 54
 Dog Hobble, 20
 Elderberry, 18
Equisetum, 13
sylvaticum, 64
 Eucalypts, Australian, 42
Eucalyptus
 Florist, 45
 Silver-dollar, 45
Eucalyptus, 42
camaldulensis, 45
cephalocarpa, 44, 45
cinerea, 45
cordata, 44, 45, 45
cornuta, 45
microcorys, 44
pauciflora, 42, 44
obliqua, 44
planchoniana, 44
regnans, 44
stuartiana, 45
tetragona, 45
Eupatorium capillifolium, 19
Evernia vulpina, 18
 Fetterbush, 20
Flaveria linearis, 18
Galium, 20
 Gloriosa daisy, 13, 14
Gnaphalium obtusifolium, 19
 Goldenrod, 3, 13, 18, 19, 20, 21, 34
 Seaside, 21
 Grape, Fox, 20
 Gum Trees, 42
 Hemlock, 22
 Hickory, 20
 Horse-tail, 13
 wood, 64
 Hypericum, 19
Hypericum, 18, 50
maculatum, 40
perforatum, 40
 Iceland-moss, 39
 Indigo, 18, 23-28, 36, 39, 56
Indigofera suffruticosa, 18
 Jointweed, 19
 Juniper, 6
Juniperus monosperma, 60
 Kawa Kawa, 48, 48
 Kowhai, 48
 Larch, 6
Leucothoe fontanesiana, (catesbaei), 20
 Lichen, Worm, 32
 Lichens, 17, 29, 50
Ligustrum, 14
 Lilac, 34
 Lily-of-the-valley, 14
Lobaria pulmonaria, 17
 Logwood, 14, 38, 55
Mactropiper excelsum, 48, 48
 Madder, 16, 20, 38, 50, 55
Magnolia grandiflora, 22
 Marigold, Cover 1, 10, 11, 13, 18, 34
 Marsh-marigold, 64
 Milkweed, 18
 Mistletoe, American, 20
 Mountain-grass, 39
 Mountain-mahogany, 62
Myrica pensylvanica, 14, 49
 New Zealand-flax, 46, 47
 Oak, 14, 22
 Black, 22
 Oak-Rag, 17
Ochrolechia tartarea, 37
 Old Man's Beard, 17
 Onion, 13, 18, 34
Opuntia, 22
coccinellifera, 36
compressa, 22
 Orchids, 31, 37, 38, 50
 Palm, cabbage, 17
Parmelia perforatum, 17
tinctoria, 17
 Pearly Everlasting, 19
Phoradendron, 20
Phormium tenax, 46, 47
Phytolacca americana, 22
 Pigweed, 22
 Plane-tree, London, 7
Platanus acerifolia, 7
occidentalis, 7
Podocarpus hallii, 48
 Poinsettia, 22
 Pokeberry, see Poke-weed
 Pokeweed, 22, 55
Polygonella, 19
Polygonum hydro-piper, 34
 Prickly-pear, 22
 Privet, 6, 14
Prunus, 20
serotina, 19
 Queen Anne's-lace, 3, 18
Quercus, 22
velutina, 22
 Rabbitbrush, 60
Ramilina, 17
 Raurekau, 48
 Reindeer-moss, 30
 Rhododendron, 14, 22
Rhododendron maximum, 19
 Rhubarb, 22
Rhus, 22
typhina, 18
 Rowan-tree, 36
Rubia tinctorum, 16, 20
Rudbeckia, 13
Rumex hymenosepalus, 61
Sabal palmetto, 17
 Sagebrush, 61
 St. John's-wort, 18, 40
Sambucus, 18
Sassafras, 6, 14
Sassafras albidum, 6
 Scallions, 6
 Snapdragon, 13
 Smartweed, 34
Solidago, 18
sempervirens, 21
Sophora microphylla, 48
Sorbus aucuparia, 36
 Sorrel, 61
 Sorti mutti, 39
 Sumac, 14, 18, 22, 34
 Sunflower, 13
 Sycamore, American, 7
 Tanekaha, 48
 Tea, 13
 Teasel, 54
Thamnotia vermicularis, 32
Thyllocladus trichomanoides, 48
 Totara, 48
Tsuga, 22
Umbilicaria, 31, 38
mammulata, 37
papulosa, 17, 37
pensylvanica, 17, 37
pustulata, 37
Urceolaria calcarea, 37
 Usnea, 17, 30
Vitis labrusca, 20
 Walnut, Black, 14
 Wild-carrot, 61
 Zinnia, 13, 18, 58
 'Sombbrero', 58

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